RADIO and ELECTRICAL Review

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

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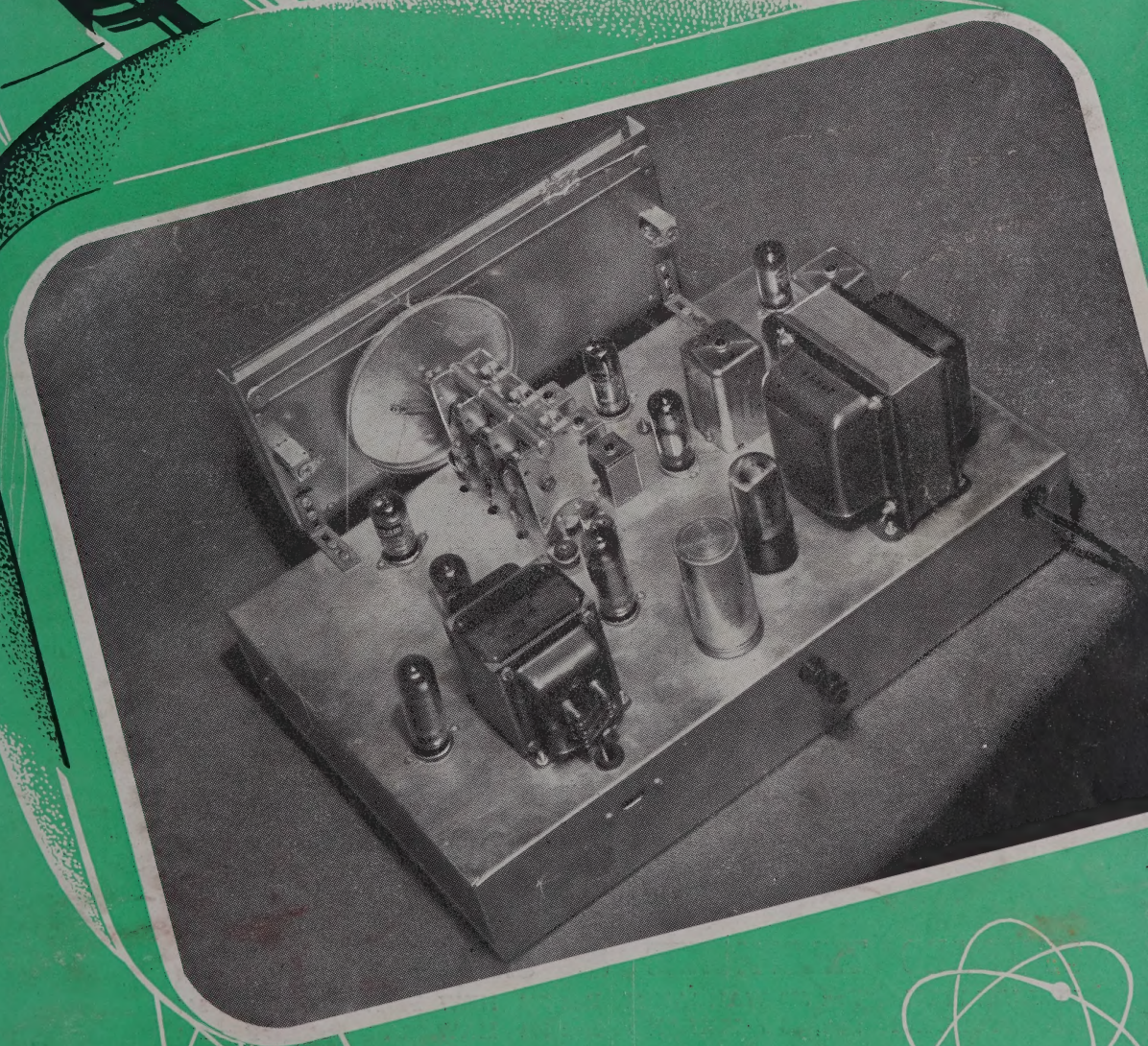

JANUARY, 1st 1956

VOL. 10, NO. 11

PRICE 1/10

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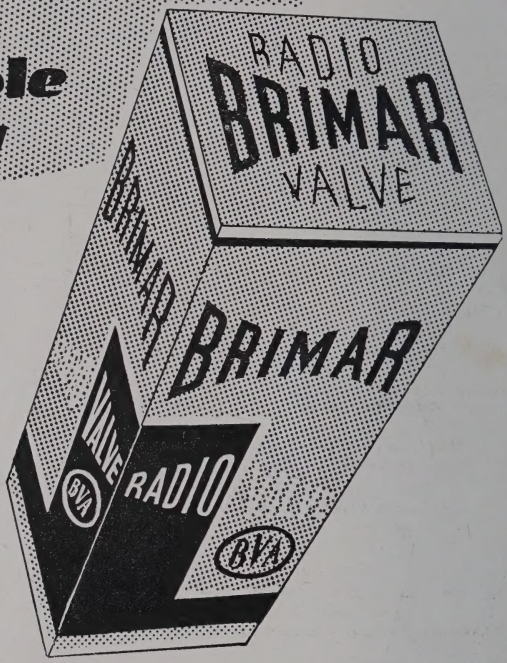

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Radio and Electrical Review

Our Cover Picture this month shows the top chassis view of the "R. & E." high quality Nine radiogram described on page 17.

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Contents

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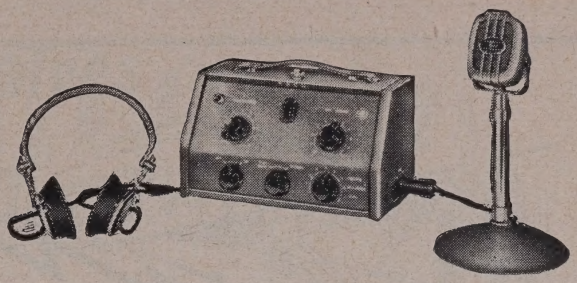
BIG NEWS FOR

VICTOR

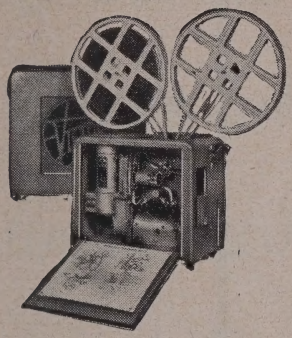
16m.m. SOUND PROJECTORS USERS



EKCO-'SOUND'

MAGNETIC ADAPTOR

For Use on Single and Double-Sprocketed Films



The Ekco-"Sound" Magnetic Equipment is specially designed to convert Victor projectors of either British or United States manufacture to record and reproduce magnetic sound tracks on oxide-striped 16mm. film. Conversion is a matter of seconds—remove the optical sound drum and exciter lamp and replace these with the Magnetic Head, which is operated in conjunction with a compound pre-amplifier and mixer unit.

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- Clip fastenings which lock the pre-amplifier on the Projector case or into the Speaker case for transit.
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The REGENTONE Self-Contained Portable Electric Gramophone

Music lovers are discriminating people. They make sure that their fine quality recordings are faithfully reproduced and that is why they choose REGENTONE electric gramophones. Make sure you have Regentone stocks on hand when your customers inquire! Every model in the Regentone range is designed to give high quality reproduction and tonal purity, and these factors combined with elegant appearance, portability and reasonable price make

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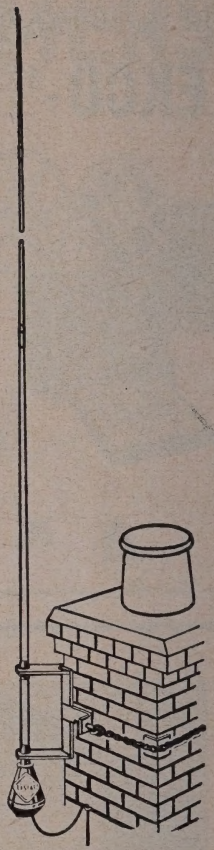
The "EXSTAT" Aerial is designed to cut out the annoyance of electrical interference and to ensure crystal-clear reception at the receiver.

"EXSTAT" has a proven record of service in town and country, and is an ESSENTIAL FITTING for all showrooms.



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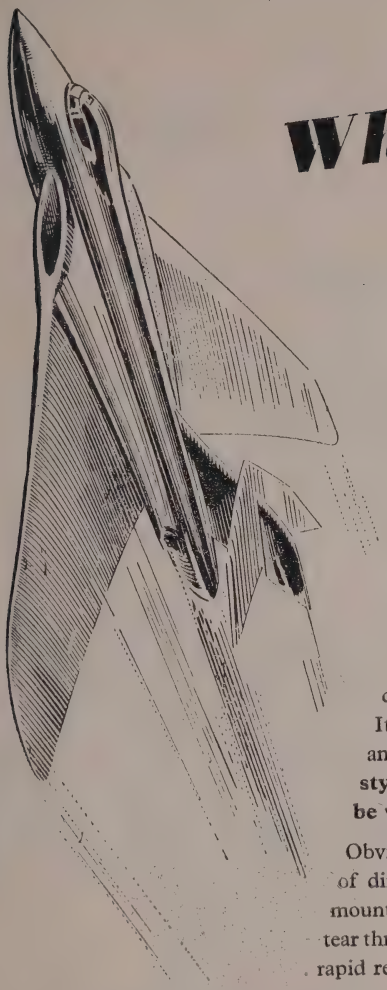

What's all this about Hi-g?

"*g*" is the symbol for acceleration which, to the technical, is defined as the differential of velocity with respect to time. More simply this means the rate of change of speed.

When "*g*" is too great, damage will be done. A locomotive leaves the rails when it takes a curve too fast. At only 6 "*g*", a pilot blacks out when he pulls out of a dive; at 20 "*g*", which is very much more than any plane can possibly encounter, the plane would disintegrate.

The stylus tip of a pick-up is subjected to the same acceleration but to an infinitely greater extent. The undulations of a record groove cause the stylus to vibrate as much as 10,000 times per second or more. It moves to one side of the groove, stops, moves to the other, stops again and so on throughout the record. **The accelerations acting upon the stylus tip are measured in "*g*" and with modern recordings may be well over 1000 "*g*".**

Obviously a light freely suspended stylus will follow rapid changes of direction in record grooves more easily than a heavy, stiffly mounted one. On a heavily recorded record a "stiff" pick-up will tear through record grooves or even jump right out of them. Result: rapid record and stylus wear and poor reproduction.

Correct tracking of modern electrical recordings with their great musical and dynamic range calls for pick-ups specially designed to cope with very high "*g*". They are available, after much patient research and development, under the name "Hi-g". **ACOS "Hi-g" pick-ups perform perfectly at any multiple of "*g*" they are called upon to meet,** representing a truly revolutionary advance in pick-up design. If you want your valuable records to reproduce as well as the makers intended—and to go on doing so for a long time—use an "ACOS Hi-g" pick-up.

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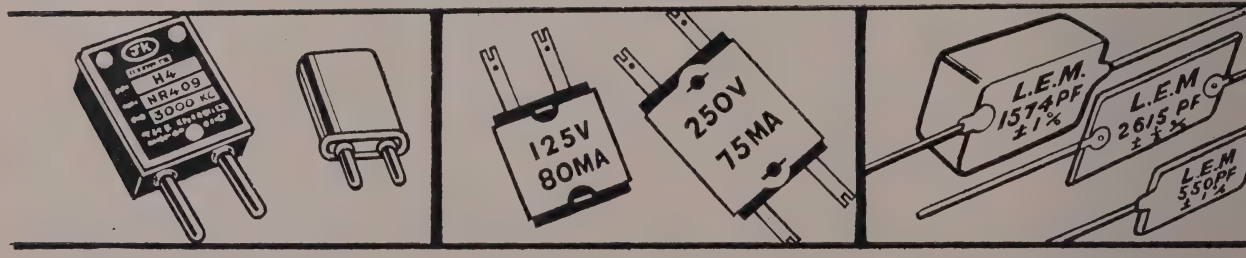

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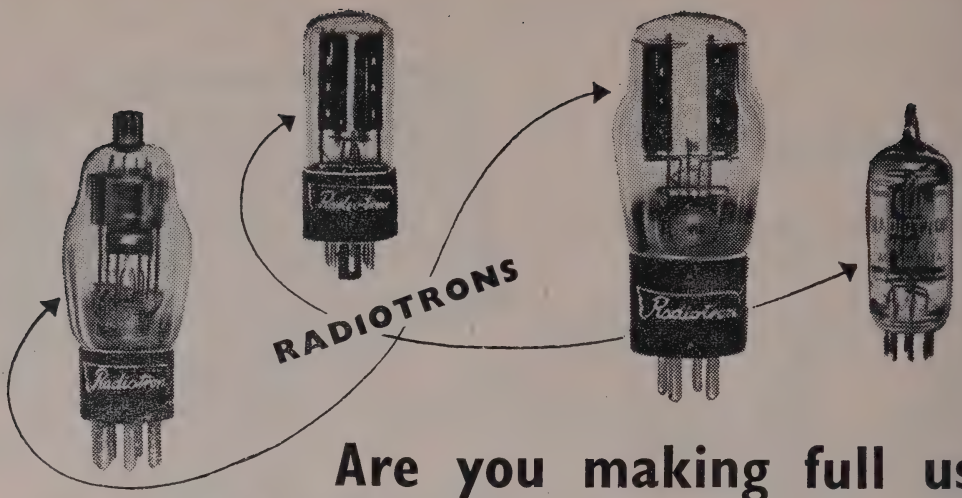

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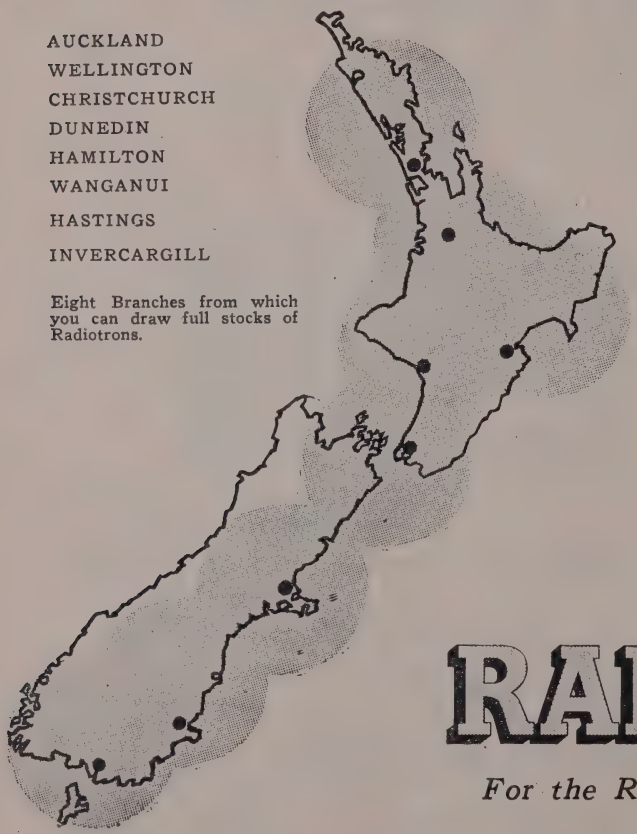

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Examinations For The Radio Trade

We have just been reading a booklet entitled "Examinations in Radio," issued by the New Zealand Trades Certification Board. This document sets out prescriptions for the trades examinations in radio. The examinations are two in number—a First Qualifying Examination, which is intended to be sat after the apprentice has completed 500 hours of his apprenticeship, and the Trade Certificate Examination, which is the final qualifying examination, entitling the successful candidate to practise his trade as a journeyman, provided he has also served the full term of apprenticeship.

The first thing to strike the interested reader is the choice of subjects which make up the syllabus. For example, the student is expected to acquire some knowledge of A.C. circuits, as one might expect, and yet he is not expected to possess any knowledge of elementary trigonometry. The principles of reflexed amplifiers are included, and yet there is no mention of tape recording or of the important quantity Q in connection with tuned circuits. Nor is there any mention of special types of receivers such as V.H.F. mobile sets, or communications receivers. Transmittters and their principles are not mentioned at all. Indeed, one reading the syllabus might be forgiven for imagining that such things did not exist. No doubt those who drew up the syllabus considered there was good reason for these and other omissions, and it is worth noting that the prescriptions have been approved by the New Zealand Radio Apprenticeship Committee. That being so, it may be said that there are no grounds for criticizing the syllabus in any respect, but we do not subscribe to that view. It takes only a superficial examination of the syllabus to reveal that, instead of being written in 1954, it could just as easily have been done in 1934, or even earlier! However, it must be admitted that the prescription does cover the bulk of the work that an apprentice should be expected to cover, and that the very existence of trade certification in the radio industry is a step forward that has been too long delayed. What does cause us some concern, though, is the fact that an examination which qualifies a man to be set loose on an unsuspecting public's radio sets, tape recorders, and, indeed, any other equipment he might possess which uses valves, does not include any kind of practical examination other than one **"designed to test workmanship in the classes of electrical work that a radio serviceman registered under the Electricians Act, 1952, is permitted to perform . . ."** The passage in inverted commas is a direct extract from the Trades Certification Board's booklet.

Surely this is a lamentable state of affairs. In effect, it implies that everyone concerned with the setting-up of the machinery of the radio trade certification has considered that as long as the trainee knows how to attach an appliance to the mains without killing himself or anyone else, the interests of the public and of the trainee himself are served. Such small matters as whether or not he can do a neat and workmanlike job on the insides of a radio set, and whether or not he has any skill in diagnosing and remedying faults in radio sets, are apparently of minor importance. The mere fact of having "served his time," and of having put in a 75 per cent. appearance at the requisite classes, is assumed to have equipped him with the necessary manual and mental skills for the job of radio servicing. But is there any sound basis for this belief? To judge by some of the work that passes for radio servicing, the answer to this question is most definitely, "No." The plain fact is that, in a practical craft such as radio servicing, no amount of theory **on its own** will make a man a good serviceman, just as no amount of practice will make a good serviceman out of one who knows no theory. The ideal to be aimed at is a judicious combination of both, as anyone will agree, but here we have a system which sets out to discover whether or not a man is properly trained for his job in life without bothering to ascertain whether or not he is able to do it at all, let alone well.

It will be argued that the trade certification system has not yet been in force long enough for any estimate of its effectiveness to be made, but in view of the fact that the old method of obtaining a serviceman's "ticket" was virtually identical to the new one, and also had no provision for a practical test of the candidate's capabilities, this argument will hardly hold water. It is not as though the standard of radio servicing is high. It is not. What can be said of a serviceman who replaces a number of paper condensers at random, and fails to find the real fault at all? True, the customer may be impressed by the honesty and neatness displayed by the tidy little packet which he receives back, containing the parts that have been replaced, but he would not be so impressed when he found that the "faulty" condensers were perfectly sound. Cases like this are all too frequent, as many members of the public can confirm. Too often, in our capacity of general consultant to the public at large, have we been asked this sort of question: "Can you tell me the name of a good firmto take my radio set to? It's been to A., B., and C. in turn, and none of them has fixed the trouble."

Now, we would not like to be quoted as saying that there are no good servicemen about. There are good ones—excellent ones, in fact—but there are not nearly enough of them. And unless the method of granting certificates is overhauled, it does not appear likely that the present system will produce very many more. Perhaps we should be glad that there is a system in existence at all, but it does appear to us that those responsible for the syllabus of instruction and the devising of the proper form of examination to be used have set their sights far too low. Fortunately, the examination cannot do much harm to the keen man who would become an excellent tradesman in any case, but it can dilute the trade with people who are not fully competent, simply because it does not aim high enough.

THE "R. & E." HIGH-QUALITY NINE

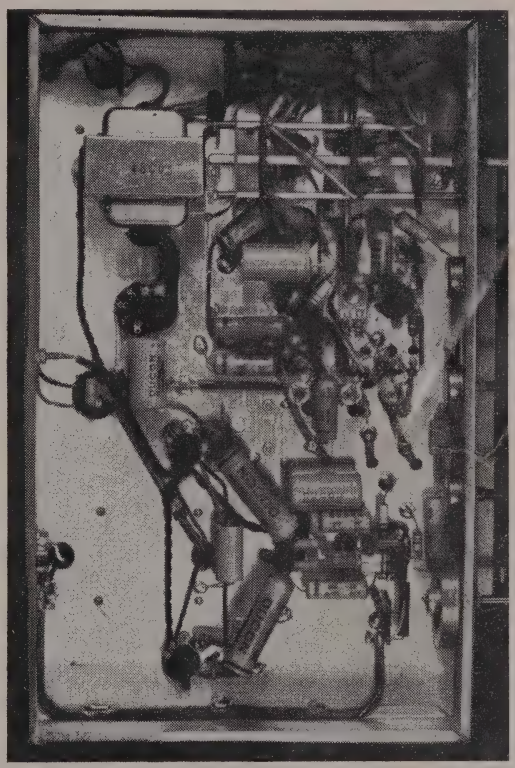
A radio-gramophone combination for the home constructor in which the emphasis is on quality of reproduction in both departments. The circuit uses the most modern valves, and the performance on "radio" is such as will appeal to those who are not in the best situations for broadcast reception. Quality on record reproduction will be limited only by the excellence of the speaker system and pick-up used.

INTRODUCTION

It is a fortunate thing for journals such as ours that those who follow our articles on audio amplification and radio reception have rather widely varying taste and requirements. At first sight, it might be supposed that when one had designed a really good audio amplifier, and an equally good high-fidelity radio tuner, the last word would have been said; this would then lead to the conclusion that until some startling new development takes place, any variation on the original designs would be uncalled for. Such, however, is not the case. Any one design is always a compromise, in which certain features are subordinated to certain others, and the manner in which these compromises are arranged is what determines the design's suitability to a given set of requirements. We were once severely taken to task by a keen reader when we mentioned this matter of compromises in connection with a certain audio amplifier which was claimed with some justification to be an excellent one. If this was so, said our reader, all we were doing was to admit that the design could have been better! According to him, the question of compromise should not exist!

The point to be learned from this is merely that any engineering design, whether for an audio amplifier, or for the Auckland Harbour Bridge, is a tissue of compromises, and that the skill of the designer is to be found in the balance he has achieved between the performance called for by the specification, and such other important matters as cost, factors of safety, and the like. For example, it is always possible to improve performance if the cost is allowed to rise, and one of an engineer's most important functions is to ensure not merely that the required performance is realized, but that the cost is not prohibitive. Similarly, where a number of design features are highly desirable, it is the engineer's job to decide which of them are not only desirable, but essential, and which, though desirable, can be done without. He may decide that all are essential, in which case the only solution is an increase in cost. On the other hand, he may decide to omit the least essential features (if we may use such a phase) thus enabling him to include the remainder at little or no cost increase.

It is because of the multitude of requirements belonging to a thing like a radio-gramophone, that an almost endless variety of designs is possible. More than this, the multiplicity of requirements makes variety necessary if the needs of the many are to be met at all completely. Thus it is that we are able to present from time to time, designs for the kind of equipment this article is concerned with, with very



little duplication. There will inevitably be similarities between one radio-gramophone circuit and the next, if only because each has roughly the same objective, but a glance at the circuits this journal has provided for constructors during the last several years will show that the similarities are quite superficial. It is realized that to some readers, the advent of a new radio-gram circuit may appear as "just another one", and it is for this reason that we are at some pains to make each one fulfill a different set of requirements. In this way we hope to provide in each new design, an arrangement which is more suited to some purposes than any of its predecessors has been.

PURPOSE OF THIS SET

Perhaps the easiest way of illustrating the main features of the set is to set them out in the form of a list, as follows:—

(1) Audio Quality

This has been regarded as the most important attribute of the design. The greatest effort, and the bulk of the expenditure has therefore been put into the audio amplifier which accounts for five of the nine valves used. The set is therefore a really high-quality audio amplifier first and foremost, and is intended for those who put quality of reproduction highest on their list of requirements.

(2) Radio Reception

This has been considered not just as a necessary evil, but as an essential. The design of the tuner has been approached from the point of view of the user who wants the best possible quality from local stations, consistent with sensitivity, which must be available for the reception of more distant ones. By this we do not mean that the tuner is an answer to the old-fashioned and almost impossible requirement for high-quality and DX reception at one and the same time. It has been designed especially with such places as Nelson and Hawke's Bay in mind. In these areas, and in others like them, there is only one "local" station and listeners are forced to do much of their listening to stations some hundreds of miles away. For instance, in Hawke's Bay, the daytime reception of the Wellington stations is good, but as soon as evening sets in and sky-wave reception starts to take place, severe fading and distortion are the rule rather than the exception. Then again, the Nelson area is notorious for its poor reception of any but the local station. Both these areas, and many others like them, call for the use of a sensitive receiver if the most is to be made of the often poor reception conditions. At the same time, when reception is good in these places, as it sometimes is, the quality enthusiast will certainly want to make the most of it. The tuner of this set has therefore been designed especially with these areas in mind. This does not mean that it will be unsatisfactory, or undesirable in any other type of locality. Far from it. Its special features can be useful, for example, to the quality enthusiast in the main centres who wishes to make the most of reception from the others, especially when conditions are good, and when the main stations are not on one of their hook-ups by land-line.

To attain the desired characteristics, a somewhat unusual tuner circuit has been arranged.

(3) Compactness

For convenience in operating, the whole circuit, including power supply, has been placed on the one chassis. This measures 16 in. x 10 in., and while not small, is not so large as to be cumbersome. At the same time, the use of noval-based valves throughout (except for the rectifier) has resulted in plenty of space being available on the chassis for mounting the not inconsiderable number of small parts. In keeping everything on the one chassis, we have been thinking of the very desirable arrangement whereby the "works" are placed together in one small cabinet, and the speaker, entirely separately, in its own baffle. With this kind of arrangement, it is important to keep all controls at the same place for convenience of operation, and this is much easier to accomplish satisfactorily when the complete circuit is in one piece, as here. If the main audio amplifier and the power supply are on a separate chassis from the tuner and pre-amplifier, and are housed in a different cabinet, complications are introduced which add nothing to the overall performance, but which do add to the complexity, and which can reduce the performance in some cases.

(4) Power Output

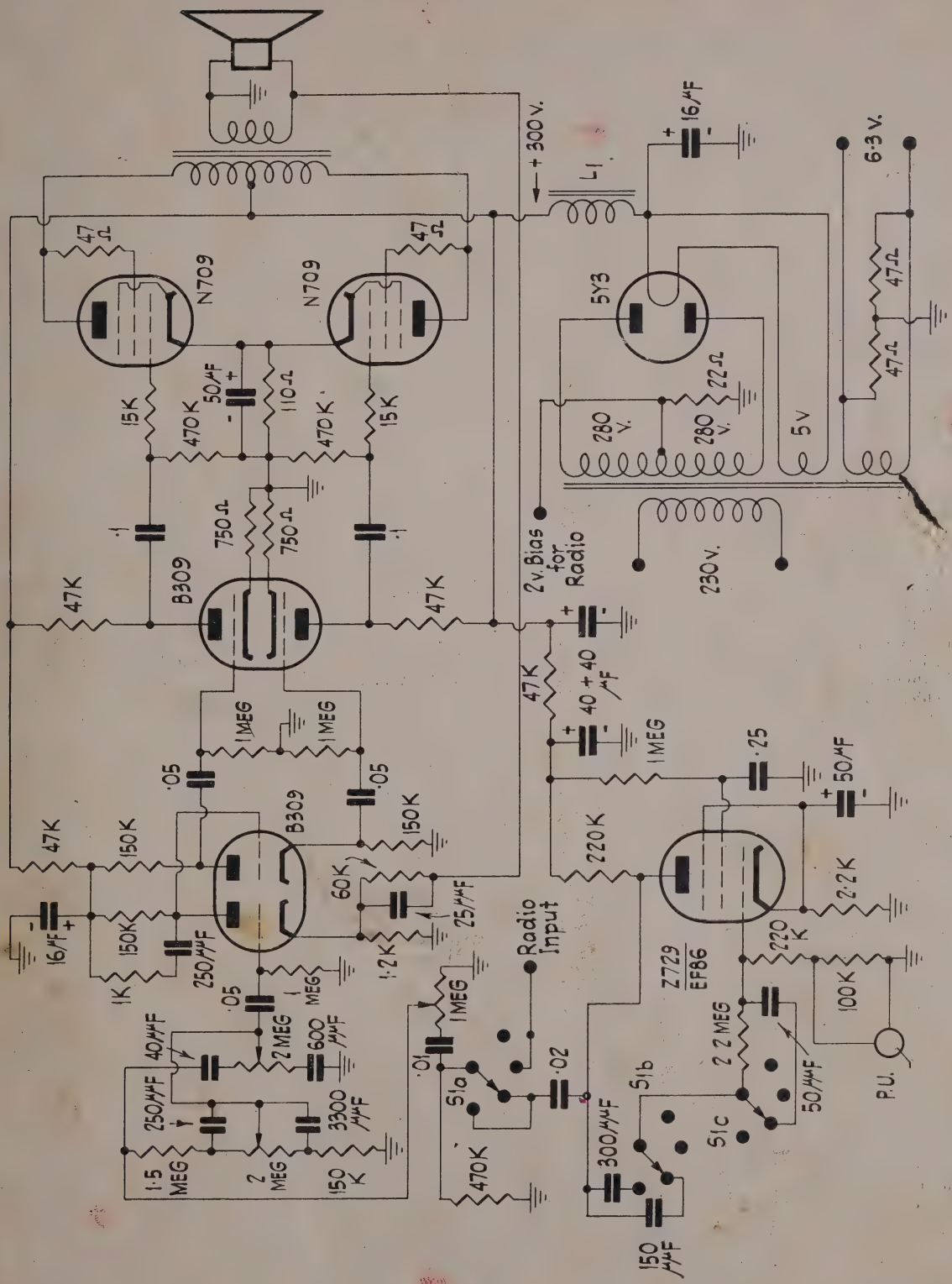
This is a most important consideration, which is too often given little or no thought by the designers of commercial equipment. In spite of what has been said to the contrary, we are firmly of the opinion that excess of power output is not only a luxury, but an exceedingly expensive one. The question is one which readers of recent articles in this journal will have found discussed fairly fully in recent months, in conjunction with articles on the square-wave performance of audio amplifiers. Briefly, if the audio amplifier is good enough (in terms of square-wave performance) the ability to produce sine-wave power outputs of fifteen watts or so is quite unnecessary. It has been found by practical test that an amplifier which will produce a square-wave output, the equivalent sine-wave power of which is 4½ to 6 watts, is sufficient to fill a hall seating a hundred people, with output power still in hand. The same power is therefore more than adequate for home purposes, and can be achieved with the highest quality at only a fraction of the cost of, say, a Williamson amplifier.

(5) Audio Facilities

For record playing, switch positions are provided giving the basic response compensation required for L/P and 78 records. Only one L/P position is given, for reasons which have been described at length in another article. The response curve is a compromise one which averages the differences between the many record characteristics, and in conjunction with the adjustable bass and treble controls that are also provided, enables the best possible results to be attained from any L/P record, without recourse to a large number of pre-set play-back curves such as are frequently found on commercial record-playing amplifiers.

Independent bass and treble "tone" controls are provided. These enable any suitable degree of boost or cut to be used at either end of the audio range, and are quite independent of each other in their action. Nor do either of them affect the general volume level, as set by the normal volume control. These controls can be used to compensate for the accoustics of the room, for the response of the loudspeaker, and for the widely differing balance between bass and treble that one finds among records, even of the same label.

The bass and treble controls are operative both on radio reception and on "Gram". This is unusual, but is a distinct advantage under some circumstances. For example, the use of bass cut instead of treble cut (which is what the conventional radio "tone-control" does) can greatly increase the pleasantness of speech when this has to be received with narrow bandwidth under mediocre reception conditions. No ordinary radio sets give this facility, under the control of the operator, nor is it given in those arrangements in which the variable bass and treble controls function only when records are being played. Similarly, conditions can be such that the use of a judicious amount of treble boost, with the tuner in the narrow band or "distant" position of selectivity, gives a better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·05
1 MEG
1·2K
25 µF
Radio Input
·25
2·2K
220 K
Z729 EF86
100K
P.U.
·01
1 MEG
·02
S1a
S1b
S1c
2·2 MEG
50 µF
40 µF
250 µF
2 MEG
600 µF
1·5 MEG
250 µF
3300 µF
2 MEG
150 K
470K
300 µF
150 µF

answer than does switching to the "wide" selectivity position, with the audio response flat.

Included under this heading is the variable-selectivity, or local/distant switch. This has two positions. A "narrow" one provides the greatest possible selectivity for distant reception. This selectivity will often be needed in localities like those we mentioned earlier in this article, because listeners in such areas often listen quite extensively to very distant stations, since they are used to what the large-town dwellers would regard as very poor reception conditions. For instance, it can often happen that some of the Australian stations provide a better signal than any of the New Zealand ones other than the local.

For listening to the local station with the best possible fidelity, the "wide" position of the switch provides greatly increased bandwidth. This position can also be used on more distant stations when reception conditions are good enough to warrant it. It is noteworthy that the R.F. sensitivity of the set is actually greater in this position than in the "distant" position, from which it can be seen that the L/D switch bears no relationship to the similarly labelled switch that used to be featured in receivers some twenty years ago. This increase in overall gain is of the order of 6 db., which is unimportant, and quite incidental to the purpose of the control.

(6) Arrangement of Controls

One difficulty that arises when a set of this nature is placed on a single chassis, is that there are more control knobs than are usually found on a radio set, with the result that it sometimes becomes difficult to find room for them all without ending up with an unwieldy arrangement of knobs. Altogether in this set there are the following controls: Volume, Bass, Treble, Tuning, Local/Distant, Radio/Gram, and 78/L-P. This is a total of seven, and even with a chassis which is 16 inches long, it would be difficult to accommodate this number without crowding, and at the same time to retain a satisfactory arrangement which fits well into the lay-out of the circuit. One common way out of the difficulty with manufacturers is to use special controls with concentric operating shafts, but as such controls are not available as stock items, some other way must be devised. In this instance, it has been possible to reduce the number of control knobs to five, without reducing the number of functions at all. This comes about because the compensation of the frequency response is required only on "Gram", while the Local/Distant function is needed only on "Radio". Because of this, it is possible to have one switch combining the three functions mentioned. There are four positions. In the first two, the tuner is operating, and these positions are "Narrow" and "Broad", or "Distant" and "Local", whichever one likes to call them. The next two positions are "78" and "L/P" respectively.

(7) Power Requirements

For a system containing eight valves and rectifier, the power supply needed is very modest. The power transformer is a 100 ma. one, 280 volts a side, and the H.T. drain is 100 ma. exactly when switched to one of the "radio" positions, and with no signal applied to the aerial terminal. On "Gram" the H.T. to the tuner is cut off and the total drain is then only 85ma. It is largely owing to this low power consumption that the set can be built so economically, because in these hard times, the price of power transformers and chokes rises rather sharply after the 100 ma. size has been reached. The same thing applies to the output transformer that was used in the original. It is a high-fidelity model rated at 10 watts audio input, but used with a maximum input of six watts. Although this may look like extravagance it really is not, because the performance of the transformer is enhanced by the low power it is asked to handle. At the same time, the output transformer, although of excellent quality, is considerably less expensive than one needed to handle an andio power of twelve or fifteen watts.

THE AUDIO CIRCUIT

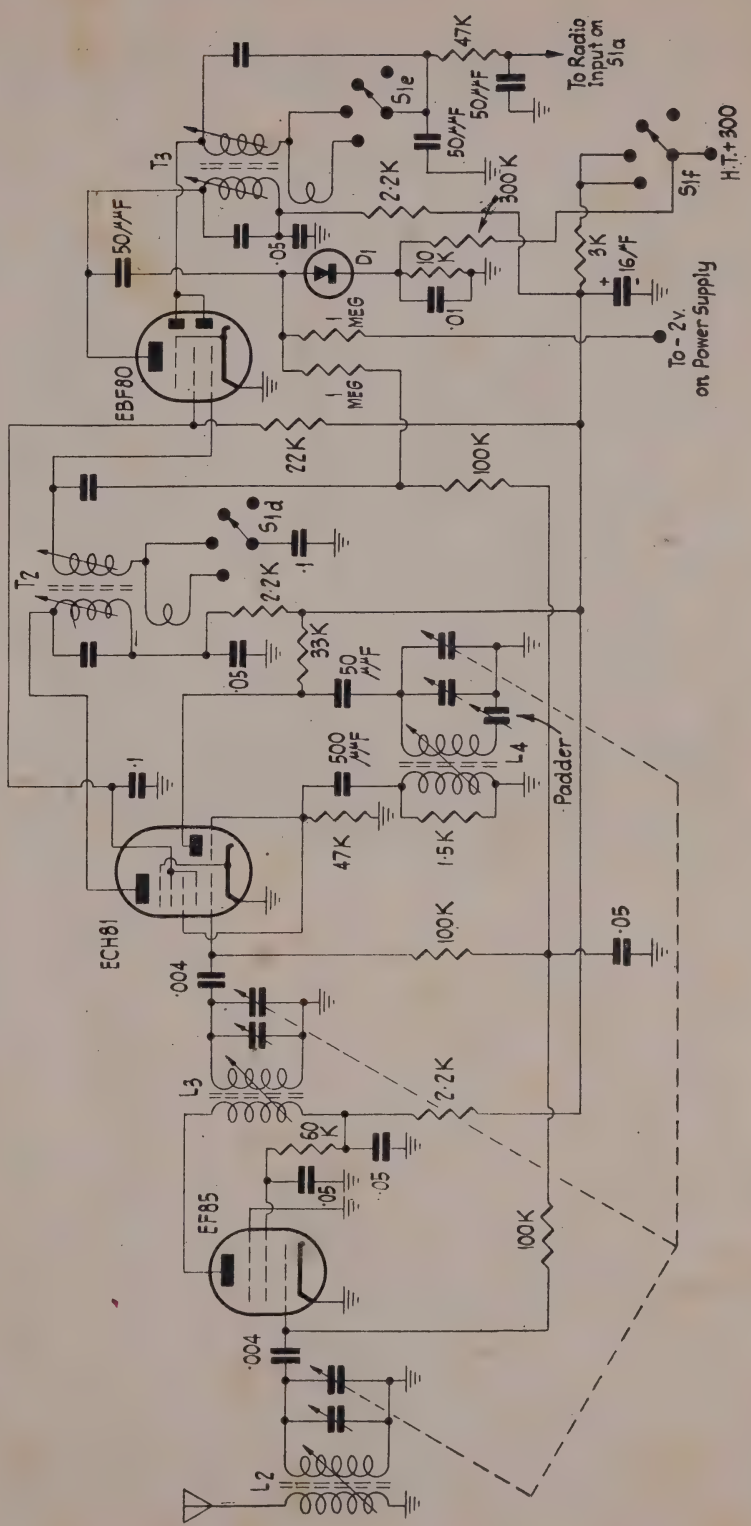
This is the heart of the whole arrangement, and a great deal of thought and practical work has gone into its development. Circuit-wise, it is very similar in appearance to the "Medium-powered High-quality Amplifier" which was described in these pages some little time ago, and which has proved to be a very satisfactory one in the hands of large numbers of constructors. The main differences are to be found in the valves used. The previous circuit used KT61s, triode-connected in the output circuit, while the present one uses triode-connected N709s. This is not because we believe the latter to be superior, as a tube, to the KT61, but simply to preserve uniformity, as all the other valves are noval-based ones. In addition, it seems likely that the noval-based types will ultimately supersede the octal-based ones, and this means that in years to come the latter will be more difficult to obtain as replacements. The remaining two valves in the main amplifier are B309s. These are high-Gm. double triodes, rather similar to the 12AX7 and ECC81. They have a high amplification factor, and, because of their high mutual conductance, a low plate impedance. They are thus admirable as audio voltage amplifier tubes, giving high stage gain and, when required, large undistorted output voltage.

The driver stage is a push-pull one using both halves of a B309. The load resistors of this stage are only 47k., as a low value tends to favour large output voltage, at the expense of stage gain. Put another way, we can say that the use of a low load resistor here gives less distortion of the driver's output voltage at the point where it is delivering the signal voltage needed to drive the output tubes fully. It is often thought that the distortion in voltage amplifiers is negligibly small, and that since there is feedback round the whole amplifier, precautions to reduce it to a minimum are unwarranted. This view is entirely mistaken. Voltage amplifiers can produce distortion up to several per cent. if their circuit values are not carefully chosen, and it is most important to ensure that the distortion of the whole amplifier is as small as possible **without feedback connected** if the best results are to be obtained. In other words, negative feedback must on on account be used as a cure-all to cover up poor circuit design. With the B309, which as we have said, has a low plate resistance as well as a high amplification factor, it is possible to achieve even lower distortion than usual by the simple expedient of leaving the cathode bias resistors unbypassed. This introduces negative feedback into the driver sections themselves, and provided that the input voltages are well balanced, as they should be, results in better characteristics for the stage than if a common cathode resistor is used for the two sections. The gain of this stage is approximately 26

times. By calculation, the distortion in this valve should not be more than about 0.17%, each half, when fully driving the output tubes.

The remaining B309 is used as the phase inverter, and as a second voltage-amplifier stage. The arrangement used is one which we have found excellent in all respects, and which can be adapted, as to exact circuit values, to suit almost any triode valve. It was first made popular by Williamson in his famous circuit, and has since been adopted by many designers who adhere to the Williamson arrangement of a push-pull driver stage preceded by a "concertina" or split-load phase inverter. When properly proportioned, the circuit is not sensitive to changes in H.T. voltage, nor is it critical in any way. This is contrary to what one would expect from the direct coupling between the amplifier and phase inverter, since direct-coupled circuits are usually most critical in their adjustment, but it is due to the self-adjusting nature of the phase inverter circuit, which is primarily a cathode follower. Any changes in the potential of the control grid are followed faithfully by similar ones at the cathode, with the result that if the circuit is properly proportioned in the first place, supply voltage changes have little or no effect on the performance. This can be proved quite easily by those interested, by feeding the 47k. decoupling resistor from a variety of H.T. voltages. It will be found that over a very wide range, the circuit functions quite normally, indicating that any small variations that may occur during the life of the valve will have only a negligible effect.

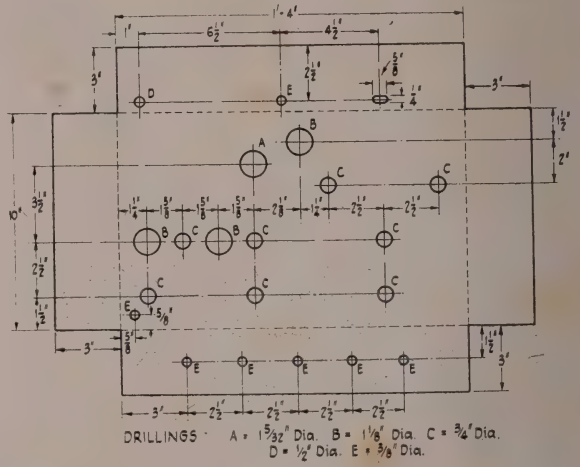
The first stage has a load resistor of 150k., so that in the absence of feedback in the stage itself, the gain of the circuit would be almost 52 times. The feedback introduced by the unbypassed cathode resistor reduces this to 36 times, which is still quite high for a triode voltage amplifier stage with a wide frequency response. Taking into account the slight loss in the phase inverter circuit, the whole voltage amplifier section of the circuit has an amplification of approximately 850 times. This seems, and indeed is, quite high, for if there were no negative feedback round the whole amplifier circuit, the maximum input voltage for the amplifier would not be much more than 10 millivolts. However, the feedback from the voice-coil winding of the output transformer to the cathode of the first amplifier stage gives a gain reduction of 18 times, or 25db., which in addition to conferring the benefits of negative feedback, brings the overall gain back to a more reasonable figure.



Even so, the main amplifier, comprising the output stage and the two B309s, has somewhat higher gain than many, but this has been done for a purpose. The network ahead of the first B309 provides the bass and treble controls mentioned above.

It is an arrangement which we have found to work extremely well, and which can very easily be incorporated in any arrangement which has enough gain available. Sharp-eyed readers will probably recognize this part of the circuit as having come unchanged from the Mullard amplifier circuit which has recently been published in book form, and which has become quite popular. A very useful thing about this tone control circuit is that it does just the job that is required, without the necessity for any special components. It really does give a control setting where the overall response is flat, and the controls do not in the least affect those parts of the frequency range which they are supposed to leave unaltered. Moreover, when ordinary logarithmic potentiometers are used for controls, the positions for flat response come very close to the centre of their travel, making it easy to obtain the settings for flat response, without recourse to instruments. However, as in all such circuits, their benefits are obtained for a consideration, and that is loss of signal level. It is impossible to obtain control over the frequency response in the desired manner without attenuating the signal as a whole, and this is why, when any such circuit is used, additional amplification must be provided in some way or other. Sometimes it can be done by adding an extra stage of amplification, but when, as here, the amplifier system is designed as a whole, additional amplification can be built into the main amplifier. It will be noticed that the volume control precedes the tone control network. This has been done so that the network can be used on both radio and gram. without difficulty. The input needed to the volume control in order to give full output from the amplifier is 3 volts peak. This may seem on the high side, but when it is considered that it takes into account the losses in the tone control network, it is not excessive by any means. The detector circuit of the tuner has been arranged so that plenty of signal voltage is available on "Radio", while the pick-up pre-amplifier looks after things on "Gram".

The pick-up pre-amplifier is used only on "Gram", as any gain it could provide is not needed on "Radio". The circuit does not need much comment, as it is our well-tried negative feedback arrangement, which is so versatile. In this application it was necessary for the pre-amplifier not only to give the essential response compensation, but also to have some overall gain as well. The circuit has been arranged more especially to suit the high-quality low-level crystal pick-ups that are having such well-deserved success at the present time. However, one of the great advantages of having a separate pick-up pre-amplifier tube is that whatever type of pick-up one proposes to use, the pre-amplifier can readily be modified to suit, without having any effect on the rest of the circuit. It is important to note, though, that the circuit as it stands, is quite suitable for use with most high-quality magnetic pick-ups. The reason for this is that the well-known trick has been used whereby a crystal pick-up is shunted heavily enough with resistance to give it the same constant-velocity charactertistic that is possessed by all good magnetics, thus enabling the same compensation to be used for both. However, should readers be in any difficulty about the correct way of treating the pick-up of their choice, we will be pleased to assist them by making suitable recommendations, on request. The actual amplification of the pre-amplifier stage is 7½ times. This gives an input of 0.4 volts peak, for full output from the amplifier. This is ample, and enables the amplifier to be fully loaded from the least sensitive pick-up that is likely to be used. In this connection, it should be mentioned that the output levels quoted on the data sheets that go with most pick-ups are almost invariably on the low side. For example, the pick-up that was used with the prototype for testing, and which is intended to be used with the complete set-up, is



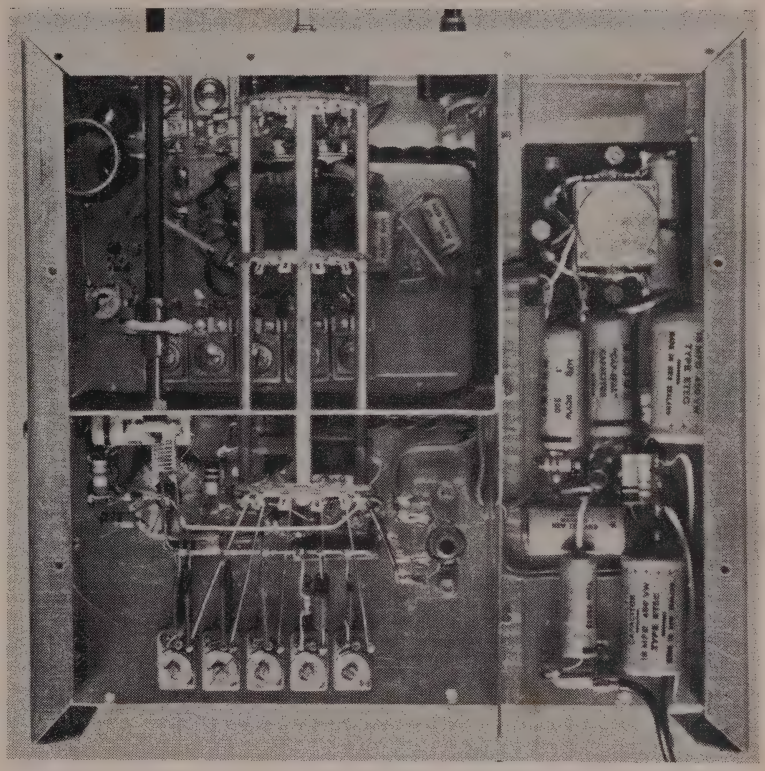
quoted as having an output of 0.15 volts under stated conditions of stylus velocity. We do not doubt the maker's stament at all, but to the uninitiated, this figure gives a rather pessimistic view of things, for the test conditions quoted by the maker by no means approximate the actual output given by the loudest passages of music on an L/P record. From experience, we would place this at between 0.5 and 1.0 volt peak, from which it can be seen that the circuit is quite sensitive enough for this particular pick-up.

The switching of the input of the amplifier from the output of the tuner to that of the pick-up pre-amplifier is accomplished by S_{1a}. The next two switch sections, S_{1b}, and S_{1c}, are concerned only with changing the circuit of the pre-amplifier from 78 to L/P compensation. Altogether, there are six four-pole sections to the switch S_1. There are three wafers only, because each wafer accommodates two four-pole sections. Because of the size of the whole circuit, we have drawn the audio and radio sections separately. This should not cause any confusion, because the only electrical connections between the two sections are the power supply leads and the tuner's output circuit, which is connected to S_{1a}. The section S_{1f} has the job of connecting the H.T. to the tuner in the two "Radio" positions of the switch, and disconnecting it on "Gram". This section will be found on the drawing

(Concluded on page 52)

THE SYNCHRODONE—MARK II VERSION

Unfortunately, we were not able in last month's issue to give a photograph of the construction of the new version of the synchrodyne, to show how the construction differs from the original. The photograph has now been taken, and we print it here for the benefit of those interested.

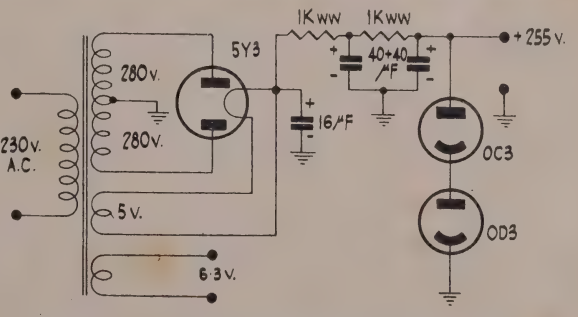


It can be seen that the general arrangement remains unaltered, but that different types of air-dielectric trimmers have been used, and that the main modification concerns the positions of the wafers of the main switch. In the new version, two wafers appear in the R.F. amplifier compartment, the extra one being for the switching pre-set aerial series condensers. No more banks are used, since in the modification, one bank is no longer needed for switching the voltage divider in the locking circuit, which is now fixed in value. Also to be seen is the midget variable condenser which is permanently in circuit in the oscillator, irrespective of switch position, and which is brought out to the front panel to act as a "tweaker" in case adjustment should be needed just after the receiver has been switched on, or again after it has warmed up. The improved arrangement has actually been found more stable than the original, with the result that it now operates for several days at a time without any adjustment having to be made.

Also to be seen in the photograph is the construction of the demodulator circuit, in which the transformer and diodes have been mounted and wired as a separate unit on a piece of paxolin board, which is afterwards mounted on the chassis and connections made to the rest of the circuit.

POWER SUPPLY FOR THE SYNCHRODYNE

Although it has not been found essential to operate the synchrodyne from a regulated power supply, it is a good thing in principle to do so. Fortunately, the current drain is not very high, and is also constant, which makes a regulated supply easy to design and build, using only ordinary glow-tube regulators. The circuit diagram is given here of a small unit that was built to power the Mark II version, but it would be equally satisfactory for the original model. A 280 volt-a-side, 60 ma. power transformer is used, not because 60 ma. is needed, but because this is the smallest stock transformer that gives a high enough voltage. Resistors are used instead of a choke for smoothing, and this more than makes up for the expense of an extra electrolytic condenser. The 1000 ohm resistors should have a rating not smaller than 2 watts, and in order to allow them to run cool, 5 watts would be better. On no account should a small electrolytic condenser be used at the output of the filter, as doing so may result in the relaxation oscillation taking place.



Finally, we would advise those who who would like to build the new version of the synchrodyne as closely as possible to the original, to take advantage of our technical photograph service, whereby enlarged prints from the original negative may be purchased from our office at a reasonable figure.

Recording

CIRCUITS FOR MODERN TAPE RECORDING
PART 3: RECORD AMPLIFIER CIRCUITRY

INTRODUCTION

In part I of this series, readers will remember that the discussion centred round the frequency response characteristic of uncompensated tape recordings. It was shown that with constant audio current in the recording head, the response consists of a linear rise at 6db. per octave, from the lowest frequencies up to some 1500c/sec. or so, after which the response flattens off, and falls again. This flattening off of the curve is quite gradual in practice, and at speeds of 7½ in. per sec., with modern tape and heads, the point where the response is 6db. below that at the peak of the curve is in the region of 7½kc/sec. At 15kc/sec., the response is 18 to 20db. down from that at the peak of the curve.

It will be remembered, too, that in order to ensure interchangeability of recorded tapes from one machine to the next, irrespective of where the recording was made, it has been made standard to perform equalization for the falling response at the low-frequency end during playback. Doing this results in the use of a standard response curve for all playback amplifiers, and the scheme is a practicable one because for frequencies up to the turn-over (approximately 1500 c/sec.), the response is almost independent of the characteristics either of the tape used, or of the record playback head.

With the playback amplifier's response curve fixed in this way, and with equalization at the higher frequencies left still to do, it is clear that this equalization must be done during recording. Similarly, since equalization below the turn-over frequency has been done during playback, no equalization is required below 1500c/sec. during recording.

From these considerations, it is plain that in this frequency range, the recording head must be fed with **constant current**, because this was the original assumption from which the argument about response equalization was commenced.

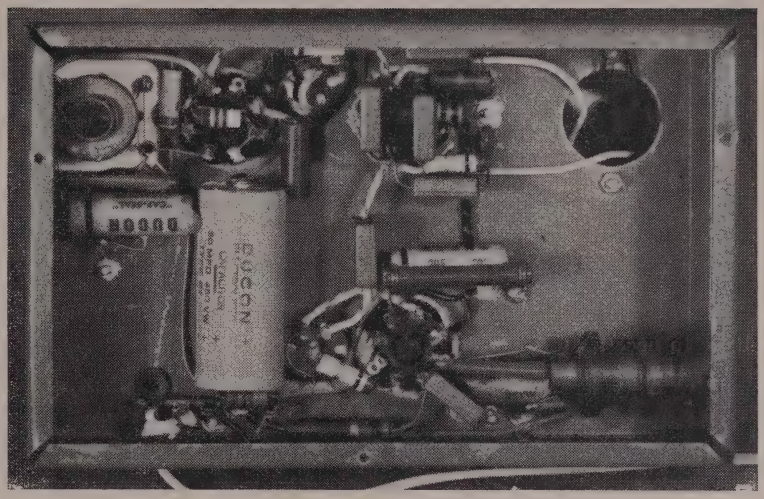
Thus, in order to see what kind of frequency response the record amplifier must have, we must first of all consider what is involved in feeding the head with constant current at all frequencies from the lowest (say 30c/sec.) to 1500c/sec., and to do this, we must take into consideration the electrical characteristics of the head itself.

CHARACTERISTICS OF THE RECORD HEAD

The head is quite a simple device, fundamentally, being nothing more than a coil wound on a core of mu-metal, or other magnetic material. The gaps in the core are very minute, so that they will have very little effect on its electrical characteristics. The head will obviously have quite a large inductance, on account of its iron core, but the value of inductance will vary quite widely according to the detailed design. All heads however, will have one thing in common, namely that at all frequencies inside the audio range, the impedance will be predominantly inductive. Now no such thing as a pure inductance exists, because any actual inductor possesses both resistance and self-capacity, but at low frequencies the latter can be ignored. By saying that the impedance of the head is predominantly inductive, we mean that it can be regarded as a large inductance in series with a (relatively) small resistance. Thus, in evaluating its behaviour at different frequencies, we will not be much in error if we forget about the small amount of resistance, and regard the thing as a pure inductance. If we do this, its impedance is the same thing as its reactance, and so is equal to $2\pi fL$ ohms, where L is the inductance in henries, and f is the frequency in cycles per second. Thus, we find that the reactance, and therefore the impedance (since we have conveniently forgotten about the resistance), is directly proportional to frequency. If we feed the head from the plate of a triode amplifier, for example, the following effects will be noticed, as the frequency is raised from the lowest upwards. The triode will apply a constant voltage to the head at all frequencies; therefore, if the audio voltage across the head is constant, as it would be in this example, the current in the head would be **inversely** proportional to frequency. That is to say, if the current through the head is x ma. at one frequency, it will be only x/2 ma. at twice that frequency, and so on. From this, we can

View of the bias and erase unit whose circuit was discussed last month. The co-axial sockets take the 55kc/sec. signal to the record and erase heads, and the pre-set bias and erase output controls are mounted on top of the chassis for easy access.

see that feeding the head from the plate of a triode amplifier would give anything but constant current in the head. What, then, can be done to feed constant current to the head from a conventional amplifier, which is a constant-voltage device? The most commonly used practical solution is to swamp out the inductive reactance of the head by putting resistance in series with it. If we do this, and the value of the resistor is much greater at any frequency than the reactance of the head, the composite circuit comprising the head plus the series resistor will have an almost constant impedance at all frequencies. If now the combination is fed from the plate of an ordinary amplifier stage, the current through the head will be the same at all frequencies, and we will have achieved our requirement for constant-current feed to the head.



Underneath view of the bias and erase unit. Note how the coils for the bias and erase amplifiers are mounted at right-angles to each other, and well spaced apart. The oscillator coil is in the shield can.

In passing, we might mention that there is another method which has been used in actual tape recorders, but which is rather more difficult to apply. It is to feed the head directly from the plate of a pentode amplifier stage, without any series resistance. In this case, the pentode is a constant current generator, because of its very high plate resistance, and the same effect is gained. The series resistor method, however, is so much easier to use in practice that one seldom sees any other arrangement. Sometimes, instead of feeding the head from the plate of a triode directly, one sees a head transformer-coupled to the amplifier. The system of obtaining constant current is the same, however, because in that case there will also be a resistor in series with the head.

In some tape machines where the minimum of circuitry is used, there is a 6V6 or similar tube, which is used as the speaker amplifier on playback, and is switched to feed the head, via a special secondary on the output transformer, on record. The commonest arrangement, though, is to use the 6V6 as bias oscillator on record, and to switch a small triode, such as half a 6SN7, from playback, where it acts as one of the amplifier stages, to record, where it acts as the output tube feeding the head and its series resistor.

SOME PROBLEMS THAT ARISE

Fortunately, the audio voltage that needs to be applied to the head during recording is quite small. The figure varies from head to head according to the actual impedance. Heads are classified as high- or low-impedance, according as they have coils consisting of many or few turns. There are advantages and disadvantages in both types, but on balance, the high-impedance variety is perhaps easier to apply. As can be understood from the foregoing paragraphs, the question of high or low impedance is purely a relative one, since the impedance varies greatly with frequency, that that of even a high-impedance head is very low at low frequencies.

The head for which the accompanying circuit was designed is a high-impedance one, and the makers quote it as having an impedance of 22k. ohms at 10,000c/sec. It can be seen therefore, that if a resistor of 100k. is connected in series with it, the impedance of the combination varies from approximately 100,066 ohms at 30c/sec., to 122,000 ohms at 10,000c/sec. This degree of variation is quite acceptable for constant-current recording at frequencies up to and beyond the cross-over frequency. Above the frequency at which the recording current begins to drop appreciably, compensation can be incorporated in the recording amplifier. It has in any case to be applied to allow for losses due to the finite size of the head's gap, and losses due to self-demagnetization of the tape. In determining the frequency response of the record amplifier, all these things can be allowed for, without actually measuring them separately, by a simple experimental method, which is applicable to any head and any kind of tape.

THE RECORDING AMPLIFIER'S OUTPUT STAGE

Since the audio power required for recording is so small, it is an easy matter to construct the output stage of the record amplifier before tackling the problem of suitable high-frequency compensation, but before this can be done, it is necessary to know how much output voltage is required from this stage. Most heads are provided with their essential operating data when purchased, and the signal voltage required is usually specified as the voltage across the head at some specified frequency. The inductance of the head is usually given at the same frequency, so that a rough calculation will show what signal voltage is required across the series combination of the head and its resistor, at the specified frequency. Since the amplifier has to provide a constant voltage output, the frequency at which the calculation is made does not matter, because whatever frequency the head information is given for the same answer will be obtained.

For the head mentioned earlier, the voltage required at 1000c/sec. is only 0.3 volts R.M.S. Now at

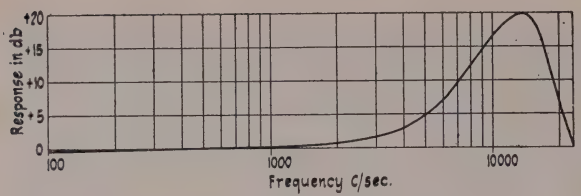


Fig. 1.—Approximate response curve of the record amplifier.

1000c/sec., the head impedance is approximately 2.2k. Thus, if 0.3 volts is across the head, there will be 13.9 v. R.M.S. applied to the upper end of the 100 k. resistor. While not great, this is a sufficiently large voltage to necessitate some consideration being given to the distortion produced in the triode recording amplifier. A typical low-impedance triode will give about 45 volts peak signal output when it has a load resistance of between 50 and 100 k., and an H.T. supply of 250 volts. At this maximum output voltage, the distortion is usually in the region of 5%, and is roughly proportional to output voltage. Thus, the ECC33, which we have chosen for our output valve, is quoted in the manual as giving the following performance as a resistance-coupled amplifier:

Load Resistor	47 k.
H.T. Supply	250 volts
Max. Output Voltage at Start of Grid Current	41 v. R.M.S.
Distortion at Max. Output	5.6%

Now the distortion can be reckoned as proportional to output voltage, so that for an output of 13.9 v. R.M.S., or 19.7 v. peak, the distortion will be $5.6 \times 19.7/58.2 = 1.9\%$. This is rather on the high side for high-quality recording, so that something will have to be done about reducing it. The first and easiest way of accomplishing this is to raise the H.T. voltage. Doing so increases the maximum output voltage in proportion to the increase of H.T. supply voltage, without increasing the distortion at maximum output. Thus, for a given output voltage, the distortion can be reckoned as inversely proportional to the H.T. voltage. Therefore, if the latter is raised from 250 to 300 volts, there will be a reduction of distortion, at the required output voltage, by a factor of 250/300, or 5/6. This gives an estimated distortion of 1.58%.

This is still too high, but fortunately, there is one factor that has so far not been taken into account. It is the loading on the amplifier stage by the circuit it supplies the output voltage to. In the data, the figures quoted above apply when the valve has to feed a load of 150 k. Now if the load is reduced, by allowing the amplifier to work into a very high impedance instead of the relatively low one of 150 k. There is a quite spectacular reduction in distortion, to about one-third of the figure obtained when the load is only about three times the value of the plate load resistor, as in the data quoted. Advantage can be taken of this by using a cathode follower between the head and the amplifier. The head circuit has a very much greater impedance than the output of the cathode follower, which is able to feed the head circuit with negligible distortion. The most important improvement comes from the very high input impedance of the cathode follower, which allows the amplifier preceding it to operate virtually unloaded, since the input impedance of the cathode follower is of the order of 10 to 20 Megohms. With a cathode follower output stage then, the disortion can be expected to be in the region of 0.5% at maximum signal level, and correspondingly less at lower levels.

One easy way of reducing the output voltage required from the record amplifier is to reduce the value of the resistor in series with the head. For instance, if this is halved, the voltage needed from the amplifier is halved also, and so is the distortion—but only when the cathode follower buffer is used. Without the buffer, the halving of the load resistance which the amplifier has to feed will increase the distortion produced, so that the improvement will be negligible. However, in practice, with the head mentioned earlier, the 100 k. series resistor and the cathode-follower buffer have been found to give very good results indeed, and this is the arrangement given in the circuit diagram. One half of the ECC33 is used as the cathode follower, and the other as the amplifier stage.

The stage gain of this arrangement is 25 times. Thus, an input of $19.7/25 = 0.79$ volts peak is needed at the grid of the amplifier stage for maximum input to the head.

HIGH-FREQUENCY COMPENSATION

We have already indicated the reasons why high-frequency compensation must be undertaken, so that the question remains of how this is to be accomplished and how much compensation is required. In order for our recorder to comply with the C.C.I.R. standard play-back curve, no high-frequency compensation is needed in the playback amplifier, but it is required during recording, if the records made are themselves to conform to the standards that have been laid down. Practical experience with modern high-quality heads and tape indicates that the response curve needed in the record amplifier must resemble that shown in Fig. 1.

The curve is flat up to the approximate frequency of the play-back turn-over, whereupon there is a gradual rise, steepening into a quite sharp peak at 14 to 15kc/sec. The level of the peak is 18 to 20db. above that of the flat portion of the curve. Above the peak, the response falls away sharply, because we are not interested in frequencies above 15kc/sec. Now there are one or two ways in which such a response curve can be obtained, but perhaps the simplest and most widely used is the obvious one—namely a circuit tuned to the frequency of the response peak. The matter is not quite as simple as that, however, because in the first place, the Q-factor of the tuned circuit must be high enough to enable the required lift to be obtained, and secondly, some means must be provided of varying the degree of lift to suit the conditions that obtain in any particular instance. If the circuit diagram is referred to, the top lift circuit can be seen in the grid circuit of the top right-hand ECC33. The circuit consists of a voltage divider, made up of a 470k. resistor in series with a 10k. resistor, and the tuned circuit, and it works somewhat as follows.

At very low frequencies, where the response is required to be flat, the tuned circuit looks like a short-circuit to ground, so that the grid circuit boils down to a simple resistive voltage divider, from which a fraction of about one forty-seventh of the input voltage is applied to the grid of the amplifier tube. At the frequency of the tuned circuit, its impedance will be very high. The exact value is controlled by a high

resistance shunting the circuit, and in this case, the impedance of the shunted tuned circuit is in the vicinity of 120k. The voltage division is then much less than at low frequencies, and may be calculated from the figures given. Now a fraction of 0.2 of the input voltage is delivered to the amplifier grid. The input at the frequency of the tuned circuit is thus just over 10 times that provided at low frequencies. This represents a boost of 20db. at the frequency to which the circuit is tuned.

When this circuit was tried and a frequency response curve run by recording the output of the audio oscillator, it was found that the required boost was obtained at the extreme top end of the range, but that there was a range between 10kc/sec. and 14kc/sec. where the boost was not great enough, resulting in a broad dip in the response curve. One way to iron out a dip of this sort, would be to lower the frequency of the tuned circuit by increasing the size of the condenser across the coil, but this would result in insufficient compensation at the extreme top end. Alternatively, shunting the tuned circuit more heavily would help to eliminate the dip, but would also do it at the expense of insufficient boost right at the top end. It appears then, that the tuned circuit alone cannot do all that is required. Most tape recording circuits have two sources of top boost because of this effect, and the correct response is obtained by adjusting the way in which the total boost is apportioned between the two methods. Sharp-eyed readers may have spotted that the circuit does contain an additional top-boosting circuit. It is to be found in the small size of the cathode bypass condenser on the record amplifier tube, immediately preceding the cathode follower. This gives a flat response out to a frequency of 1600c/sec., which will be recognized as the approximate turn-over frequency. Indeed, with the head and tape with which the circuit was developed, the use of this partially bypassed cathode resistor, without the tuned circuit at all, gave a response that was flat out to about 8000c/sec. The tuned circuit therefore gives us the upper end of the frequency range almost entirely.

REMAINDER OF THE CIRCUIT

The circuit given here contains not only the basic recording stage, which is only the circuit of the top right-hand ECC33, but includes other necessary facilities as well. Because of the quite substantial loss in the response compensation circuit, a further stage of amplification is needed. The low-frequency gain of the record amplifier tube has been reduced (by the partial omission of bypassing on the cathode resistor)

(Continued on page 31)

No. 99: The Use of Transistors in D.C. Converters—Part 2

DESIGN OF D.C. CONVERTERS

In Part I of this series, a brief description was given of the mode of operation of the transistor converter. In this instalment, we propose to describe the procedure that is used in the design of the converter, and thus show more clearly what parts of the circuit are the most important from the design point of view. This will give readers some idea of how variations in the various features of the circuit affect the final performance, and therefore of the effects to be expected when changes are made in the important features of the circuit.

As might be expected with such a simple circuit, the performance is very largely governed by the characteristics of the transformer. In actual fact, the transformer is much more important than the transistor, which is fundamentally no more than a switch. However, the high efficiency of the transistor converter is due to the excellent characteristics of the transistor when it is used as a switch. In particular, its suitability is the result of its very low resistance in the conducting direction, which enables practically the whole battery voltage to be applied to the primary winding of the transformer, only a small proportion of it being dropped across the transistor itself.

The starting point in the design of a D.C. converter is a knowledge of the voltage and current that are to be supplied to the load. The voltage of the battery is known, so that if there were no losses, it would be a simple matter to predict the primary current, because then, the input power would equal the output power. In practice, however, the losses in the transistor, the transformer, and the rectifier circuit have also to be supplied by the battery. In order to work out a design, these losses should be known, but they are not, so that the next thing is to assume some round figures for these losses. This enables a rough design to be worked out, after which the actual losses can be calculated with considerable accuracy if desired. Before the detailed design work can start, however, it is necessary to decide what the oscillation frequency will be. The choice of frequency is important for several reasons, the most important of which are the transistor losses, and the question of core saturation.

The transformer behaves no differently from any other, in that the core losses increase with frequency, while the copper losses do the opposite. The transistor losses increase very sharply with frequency, because most of the transistor losses occur during the sharp transitions from the conducting to the non-conducting state, and vice versa. As a result, the total losses show a fairly sharp minimum in the region of 1500c/sec. It is therefore good practice to operate the circuit at as low a frequency as possible if efficiency is very important. In practice, though, considerations of efficiency may be outweighed by those of space and weight. If this is the case, it is often advantageous to choose a much higher frequency because this results in the use of a much smaller core and reduces the size and weight of the transformer. If Ferroxcube is used as a core material, the optimum frequency is a good deal higher than when steel is used, because of the very low losses of Ferroxcube, even at the higher frequencies. The figure of 1500c/sec., quoted above, refers to a Ferroxcube core. Once a suitable operating frequency has been decided upon, it then remains to see how that frequency can be achieved in practice. To do this, let us quickly review the things that are known at this early stage in the design. They are:—

(1) The power output of the converter.

(2) The approximate power input to the primary circuit. (Since an estimated efficiency has been assumed).

(3) The operating frequency, tentatively decided from the above considerations.

At this point, it is necessary to remember the action which takes place in the primary circuit. It will be remembered that the collector current has a saw-tooth waveform, because the primary circuit consists basically of a constant voltage (the battery voltage less the drop in the transistor) applied to an inductance (the inductance of the primary winding). Now the rate at which the current rises from zero at the moment of switching on is directly proportional to the inductance of the primary winding. Secondly, the average (or D.C.) current in the primary circuit is known from (2) above. From these two pieces of information, and from a knowledge of the current waveform, the current reached at the peak of the saw-tooth can readily be calculated.

The oscillation frequency is known, so that the time taken for the primary current to increase linearly from zero to the peak current is also known. This is the same thing as saying that we know the rate of rise of the primary current, so that by applying the fundamental formula which states that the voltage across an inductance is equal to the inductance, multiplied by the rate of change of current, we can easily find the primary inductance which, with the known battery voltage, will allow the current to rise at the expected rate. If this inductance is then inserted in the actual circuit, by putting the appropriate number of turns on the core it is decided to use, the correct operating frequency will be obtained.

This is the first part of the design completed, and the important point to be learned from it is that the primary inductance of the transformer is governed

(a) by the voltage of the battery and the power to be taken from it and (b) by the operating frequency decided upon. But as the first of these is fixed, for any one design of converter, only the second one remains as a variable, so that it is true to say that the inductance of the transformer primary is governed by the choice of operating frequency.

One great advantage of Ferroxcube pot cores for this application, is that the data sheets for the various sizes give exact information on the number of turns required to give a specified inductance, so that at this stage, by working from the known characteristics of the core chosen for the job, the number of primary turns can be calculated. When this has been done, it is essential to find out whether or not the core will be saturated by the primary current. For the converter to operate correctly, it is clear that the core must not saturate at any part of the input cycle. If it does, the linear rise of primary current will not continue to take place, with the result that the mode of operation will change, and the expected output will not be obtained. As in any other transformer, the flux density is inversely proportional to frequency and also to the cross-sectional area of the core. Thus, by raising the frequency, a smaller core can be used without saturating the material. By the same token, it is essential to check the flux density of the core in case the flux density is so low that it would be possible to use a core one size smaller, thus saving space, weight, and expense. If at this stage the core is found to be too large or too small, the primary turns are re-calculated for a different-sized core, and the flux density re-calculated.

It should be mentioned in passing, that in most cases, the core will be used with an air-gap, because this results in much more economic use of the core material. The data sheets give all the necessary information for taking the air-gap into account, so that this presents little difficulty. Within limits, too, increasing the size of the air-gap can be used to reduce the flux density, because although doing so makes more primary turns necessary, there is a nett reduction in flux density as the air-gap is increased in size.

With the primary winding settled, it remains only to determine the size of the feedback winding and the secondary. The number of turns on the former depends on the characteristics of the transistor, and not on the input and output powers, except insofar as these have already determined the peak current to which the collector must be driven. Thus, the feedback winding must be so proportioned that, with the transistor in the grounded-emitter connection, the correct base current can flow, which corresponds on the transistor's characteristics with the peak collector current wanted. In order to allow for differences between individual transistors, it is usual to insert a resistor in the base circuit. This can then be adjusted to the value which, with the feedback voltage provided by the transformer, allows the base current to assume the value which gives the expected peak collector current. The easiest way to show how the feedback winding is calculated is to take an actual sample. The transistor is an OC15, with a peak collector current of 375 ma. Reference to the curves for the OC15 shows that a peak current of 375 ma. is obtained with a base current of 5 ma. The characteristics also show that to obtain this base current, a voltage of 0.8v. must be applied between base and emitter. Thus, the voltage that must be supplied by the feedback winding is equal to 0.8, plus the voltage drop across the series resistor, caused by the expected base current. It is a good practice to make the resistor approximately equal to the peak resistance of the base-emitter circuit itself, and this gives a value of 150 ohms for the series resistor. At 5 ma., the drop across the series resistor is 0.75v., and the total voltage required from the feedback winding is 1.55v. Now the voltage across the primary winding is equal to the battery voltage, less the drop in the collector circuit. In the example we are using, the latter is 0.4 volts, and the battery voltage is 6 volts. The voltage across the primary winding is thus 5.6 volts. Knowing this, the feedback turns can be worked out by simple proportion, knowing the number of primary turns.

The action of the secondary circuit in supplying energy to the rectifier and the load is complicated by the fact that the unavoidable stray capacity associated with the transformer forms a tuned circuit. When the peak current in the primary is suddenly interrupted by the switching action of the transistor, the energy that has been supplied to the primary by the battery, and which is stored by the inductance of the primary in the form of the magnetic field in the core, is transferred by oscillatory action to the stray capacity, in which it appears as the voltage to which this is charged. Now for a given amount of energy, the smaller the capacity of the condenser containing it, the higher the voltage must be; the stray capacity of the transformer will usually be quite small, so that the voltage produced across it will usually be considerably higher than the voltage across the secondary during the build-up of current in the primary. Now the secondary winding is so polarized that during the primary current build-up, the voltage across the secondary is in the reverse direction with respect to the conducting direction of the rectifier. Thus the latter is cut off during the build-up stroke, and the reservoir condenser is supplying current to the load resistor during this time. As soon as the oscillatory transfer of energy from the inductance of the secondary to its stray capacity starts, the voltage across the secondary is reversed, and so is in the right direction to allow the rectifier to conduct. As soon as the stray capacities have been charged up to the voltage that exists on the filter condenser, the diode starts to conduct, and the energy that would otherwise simply oscillate between the capacity and the inductance of the secondary circuit if the rectifier were not there, is transferred to the reservoir condenser by the conduction of the rectifier.

From a consideration of the above mechanism, it can be shown that the inductance required in the secondary winding is inversely proportional to the frequency, and directly proportional to the D.C. load resistance. It appears, therefore, that the number of secondary turns bears no simple relation to the obvious consideration, namely, the ratio between the primary voltage and the voltage required across the load. In practice it is calculated from the resistance of the load circuit, and from the mark-space ratio of the square-wave of oscillation. When the required inductance has been found, the number of turns on the secondary is found from the core characteristics that have already been read from the data sheets in determining the number of primary turns.

When the number of turns on the three windings has been determined, a trial transformer can be constructed and the circuit tried out. It has been found

by using the design procedure outlined above, that except where there is some doubt about the characteristics of the transistor (as is the case at very high peak currents, where intelligent guesswork must be used in extrapolating the transistor curves) only very minor departures from the initial design are needed. Also, where the peak flux density is below the saturation value for the core, reasonable changes in output power may be allowed, by adjustment of the series base resistor, without spoiling the efficiency. Increases in power output up to 30% have been used under these conditions, but it was found that the efficiency at the greater power output is less than at the designed power output, so that re-design is advisable if more than 25% in excess of the original designed power is to be taken from the converter.

(To be continued)

THE PYE UNDERWATER TV CAMERA

(Reproduced from Pye Television Newsletter, July, 1955)

Pye Ltd. have taken a leading part in the development of underwater television equipment which, it is expected, will have considerable influence on certain diving and salvage operations in the future, as well as opening a wider field in oceanography and marine biology.

The chassis is similar to that used in television broadcasting cameras, but is housed in a cylindrical container of Duralinox alloy, a metal which is resistant to the action of sea-water. Small fittings such as nuts and bolts are of stainless steel. The container is 58.5 cm. long, with an average diameter of 33 cm., and is fitted with a large fin nearly 2,000 sq.cm. in area, so that the camera will take up the correct position in the tide and will not spin at the end of its cable.

The container is designed to resist the pressure of the water at depths down to 1,100 metres. One end is fitted with a small glass window through which the camera lens "sees," the other end being closed by the head plate to which the camera itself is attached. By removing twelve screws and so releasing the headplate, the complete camera may be withdrawn from the container. The multi-core cable connecting the camera to the control unit at the surface passes through the headplate, and special measures are taken to make the cable entry waterproof. The cable is a special one, and is also used to suspend the camera in its adjustable stirrup-shaped bracket.

The camera is dependent on light conditions for its range of vision, and some form of artificial lighting is required when operating in deep water. Lighting is provided by a 250-watt spot lamp, which may be focused by remote control to give a spot or a diffused effect as required by circumstances.

All operational adjustments to the camera are made from the control unit at the surface. These adjustments include focus, iris setting, and lens changing. Up to three lenses may be fitted to the turret, the range of lenses being from 35 mm. to 50 mm. focal length to give horizontal angles of view from 58 deg. to 35 deg.

The overall dimensions of the control unit are 36 x 27 x 53 cm. It incorporates the normal camera control unit circuits for generation of scanning waveforms, synchronizing and blanking pulses as well as the remote-control facilities, and a built-in power conversion unit for camera operation. The total power consumption approximates 400 watts.

A picture monitor to complete the viewing system is of the same overall size as the control unit. The compactness of the shipboard equipment makes modest demands on the accommodation afforded by even a small vessel.

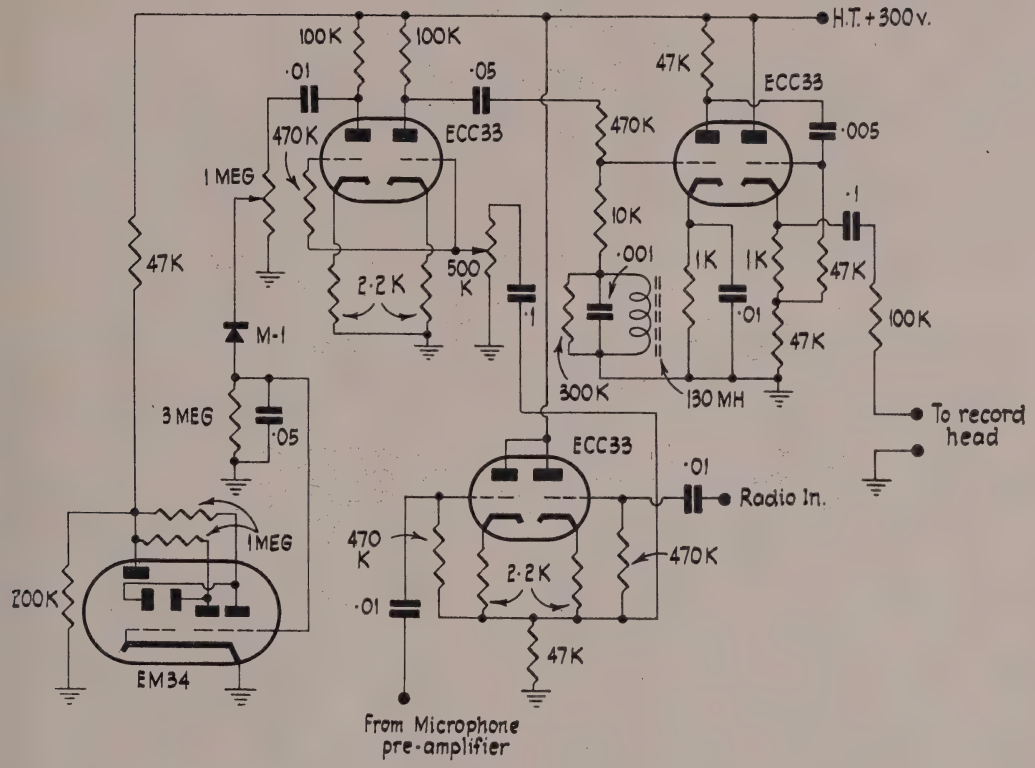
Meter indication is provided on the control unit giving information about the camera, including the depth at which it is operating and its angle of tilt. Seepage of water into the container due to accident is also immediately recorded on a meter, so that the camera may be raised before extensive water damage occurs.

A probe is fitted to the camera measuring some 4 metres in length, and projecting in front of the tube. This gives good indication of the camera distance from an object, since both probe and object are visible on the monitor screen.

Research is now proceeding to provide a pan and tilt head for the camera capable of being remotely controlled and suitable for existing cameras as well as for future models.

Tape Recording

(Continued from page 27)



to some 16 times, instead of the original 25 times. The actual low-frequency voltage division in the grid circuit is 1/25, so that working from the figures already given it can be shown that the voltage needed at the output of the preceding amplifier stage is about 30 volts peak. The preceding amplifier, with a load resistance of 100k. can supply this easily, with low distortion, and this stage is operated with an entirely unbypassed cathode resistor in order to reduce this still further. The gain of this stage is approximately 17 times, so that a signal of some 1.8v. peak is required at the grid of the preceding stage. At this point, the recording amplifier's gain control has been inserted, and is the 500k. potentiometer.

Fundamentally, then, the recording amplifier, as described so far, consists of a two-stage triode amplifier, with a cathode-follower output stage. The one remaining essential part of the circuit is the level indicator, which uses an EM34 magic eye tube, and one half of the upper left-hand ECC33.

The signal from the volume control is fed simultaneously to both halves of the ECC33. The right-hand half is in the recording amplifier, as previously described, but the left-hand half is solely concerned with the volume indicator circuit. Its output is fed to a 1 Meg. potentiometer, which in turn feeds a small selenium rectifier or crystal diode. The output of the rectifier is smoothed to remove the audio component by a 0.05μfd. condenser across the 3 Meg. load resistor, and the resulting D.C. signal, which is proportional to the audio signal level at all times, is fed to the control grid of the EM34 magic eye tube. The 1 Meg. potentiometer is a pre-set control, governing the sensitivity of the magic eye, and is adjusted so that with the known maximum signal level fed into the input of the record amplifier, the less sensitive shadow of the EM34 is just not closed. Then during recording, the level is set by watching the shadow of the EM34 and adjusting the recording gain control so that on peaks, it just does not overlap.

The remaining ECC33 is an audio mixer, enabling either or both of two audio inputs to be fed into the record amplifier. It consists of two cathode followers with a common cathode load resistor. This is a highly efficient method of mixing audio signals without either interaction or distortion. One has been labelled "Radio In", and can be fed from the detector or the voice-coil of a radio receiver. No gain control has been provided at the input, because the volume control of the radio set itself can be used for this purpose. Any microphone that is likely to be used will need additional amplification; how much is provided will depend on the microphone, but a diaphragm-type crystal, for example, will be able to make do with a single high-gain pentode stage, as

(Continued on page 51)

RECORD TALK

By JOHN GRAY

The companies have been jostling one another in their eagerness to present us with "The Ballad of Davey Crockett", and as the records seem to have preceded the Disney film we must take the tune merely for what it is, a good melodious number. Mr. Crockett, we are told, has now supplanted all other Western heroes in the imagination of Americans and, by implication, of New Zealanders. At any rate he has inevitably made by the Hit Parade and my own choice, based admittedly on limited acquaintance, is of Tennessee Ernie's version on Capitol CP 403. The reverse is "Farewell", which turns up also on the London version (NZL 101, the singer being Bill Hayes). Philips, however, have the original sound-track recording by Fess Parker, and in their excitement tell us everything but the record number which, according to subsequent information, is B 21565. To complete the Crockett chronicle, Mercury have it by Rusty Draper on M 4132.

Festival's version of "A Man Called Peter" appears on a 45 (SP45-684) coupled with "My Cathedral"; the singer is Daryl Stewart who was here with the "South Pacific" company some time back. Sophie Tucker is now enclosed on an extended play disc (45XP-675) and dispenses her usual advice in four forthright numbers. The LPs this month offer Festival's usual mixed bag, from Woody Herman through Camarata to an unknown Dvorak symphony. Herman's "Blues on Parade" lists eight numbers containing the word "blue", either singular or plural, as part of their eight selections joined together under an elegant title, "The Dirty Dozens", which turns out to be merely the name of one of the said tunes. I have been intrigued by one or two Camarata titles (CFR10-709) and Count Basie on another LP (726) has discs on which that gentleman conducts a large orchestra in several "operatic arias", in which the numbers themselves are played simply as "instrumentals", a variation of the Kostelanetz Opera for Orchestra series. On CFR10-713, for instance, there are dressed up versions of tunes from "La Boheme", "Gianni Schicchi" and "Madame Butterfly", while 712 contains, among other selections, a large slice of the Temple Scene from "Aida". There are obviously many who like operatic melodies without the high tenors and sopranos who normally belong with them, and these discs are today's substitution for the dear old potpourris by the "Grand Symphony Orchestra" which we were offered in days gone. Another LP, CFR10-730, introduces an almost legendary figure, the late and great baritone Giuseppe de Luca, who recorded a recital of old Italian songs, just prior to his death about five years ago, at which time he was quite an old man. As the record begins and the quavering voice is heard intoning "Caro mio ben" we wonder how we are going to survive such an embarrassing display of age and infirmity: it is not long before we are both touched and enthralled by superb artistry and deep understanding of the art of singing. Here is a genuine "golden age" singer whose art, even if past its vocal prime, is preserved for us in a modern recording, a treasure which no lover of Italian song should allow him or herself to ignore. The superb recording by Westminster of Gliere's "Red Poppy" ballet suite, formerly released as the fourth side of a large-scale symphony by the same composer, is now available on its own as the first issue of Westminster's "laboratory" series, made expressly for professional equipment. The sound was fabulous enough in the first instance, and this special pressing should yield untold delight to hi-fi fans. The symphony of Dvorak's, referred to above, is an early work in E flat, which was written in 1872. Somehow the "unknown" works of this composer have a habit of producing more musical delight than those of any other of his period, and so it is in this case. The work is played by the Vienna Symphony Orchestra under Henry Swoboda on Westminster WL 5029. Before leaving the Festival series I must hail the appearance of a folk song disc by those delightful artists Josef Marais and Miranda. On CFR10-727 they are heard in a string of delicious ditties ranging from "Go Tell Aunt Rhody" to "Waltzing Matilda".

With the general release of "Kismet", the musical show for which Borodin has posthumously supplied the melodic substance, there has been a great upsurge of the hit tune, "Stranger in Paradise", Mercury being well to the fore with their Vic Damone rendering on M 4133. This company is the latest to enter the extended play 45 sphere for their classical releases. There is an attractive set of Brahms waltzes played by duo pianists Abram Chasins and Constance Keene on EP1-5058, and an uncut "Tales from the Vienna Woods" by Dorati and the Minneapolis Symphony on EP1-5023, while on 5066 the American Fine Arts Quartet can be heard in two first rate short pieces, the little Schubert C minor quartet movement and Mendelssohn's delicious "Canzonetta", an issue that might well be recommended to all who enjoy string quartet playing but who are perhaps not attracted to larger works.

Les Paul and Mary Ford have a typically suitable vehicle in "Humming Bird" on Capitol CP 432 and Joe "Fingers" Carr is well up to form on CP 430 with "The Daughter of Rosie O'Grady" and "Narcissus". On LP, the original Broadway cast give us what is virtually the complete score of the Cole Porter musical, "Can Can", one of the brightest shows of recent years (CLLX 023). For the children, Bugs Bunny is back again and, by way of a change, he meets Hiawatha on CK 045. Tanza continue keeping local artists well to the fore, and it was a wise move to have Daphne Walker remake the "happy birthday" song, "Best Wishes", with which this company had an early success in the Pixie Williams' version. The number of this new one is Z 261, and the other side has a new Sam Freedman tune "An Okey Dokey Hut". As usual Bill Wolfgramme's Hawaiians are in support.

Argo have come up with a recording of "The Beggar's Opera" on three discs, RG 76-78, which employs the happy device of a "double cast", singers for the songs and actors for the dialogue. The role of MacHeath, for example, is sung by the veteran Dennis Noble and acted by Norman Shelley. This is, by the way, the well known Frederic Austin version which ran for so long at the Lyric, Hammersmith, shortly after World War I. In these days when all sorts of obscure operas are offered complete, it is perhaps strange we have had to wait until now for a recording of one of our greatest national treasures, but the inevitable has of course happened, for this new Argo set is scarcely off the presses ere we learn of a rival H.M.V. version under Sir Malcolm Sargent! But for once let's follow the "bird in hand" principle, for the Argo is actually here and the other is at least some months away. The conductor is Richard Austin and in the "Argo Chamber ensemble" which provides the accompaniment we note the names of such fine instrumentalists as Leon Goossens, Jean Pougnet and Anthony Pini.

There is good light music on Nixa, either in extended 45 or LP form. In the first bracket is the Harry Arnold orchestra, Ray Martin, and Petula Clark, while the first and third of these appear on LP also, Arnold with a Cole Porter selection (NPT 19001) and Petula Clark in seven melodious items (19002). Nixa have also a handy coupling of the Bach concertos for two keyboards, in C minor and C major respectively, played by the two-piano team of Appleton and Field with an orchestra under Frank Brief (NCL 16007). Then there is another bewilderingly large release of the Deutsch Grammophon Archive series. Any millionaire who could afford to buy this would undoubtedly own an unrivalled treasury of music from Gregorian Chant to the eighteenth century. This new batch represents successively the "High Renaissance", with a disc featuring social music of Italy (APM 14052) seventeenth century German baroque music, with a collection of vocal compositions by Adam Krieger (APM 14035), French music, both vocal and instrumental, from the Court of Louis XIV, which was certainly one of the most musically active of all royal establishments (AP 13027), and an intriguing "Comic Cantata" by the prolific Telemann (APM 14025). In their regular series, DG are consolidating their list of standard classics. There is the expected amount of Beethoven and Brahms, some Mozart, and the Dvorak violin concerto as played by Johanna Martzy with the Berlin RIAS orchestra under Fricsay. The catalogues are so overloaded with standard works that we are tempted to give no more than a passing nod to such releases. What does make us open our eyes is the appearance, in whichever company's repertoire, for something quite off the beaten track. DG thus claim attention with Rossini's "Stabat Mater" in its first appearance here (DGM 18203-4). There is a general impression that Rossini's religious works, which came long after he had given up the operatic stage, were written with tongue in cheek and are of small account. But those whose tastes are not too austere will agree that there is surely nothing wrong with good tunes, even in church music. This Stabat Mater has some thrilling moments and the Berlin performance on these discs, conducted by Fricsay, has four fine soloists, including the splendid Finnish bass, Kim Borg, who is rapidly establishing himself, even in a world where there is nowadays an abundance of really fine basses. Rossini's work occupies three sides, and the fourth is given over to a modern masterpiece, Kodaly's "Psalmus Hungaricus", on the face of it a strange bedfellow, but there is no reason why lovers of Rossini should not investigate the delights of Kodaly—and vice versa. For chamber music devotees there is an issue of Ravel's lovely Quartet as played by the Loewenguth Quartet of Paris, and ballet fans who have not yet added "Petrouchka" to their collections may be advised of a release by Fricsay and the RIAS orchestra of Berlin on DG 17003.

Another new label has joined this group, Polygon, which obtains its material from the fine Vanguard catalogue published in America. In the initial release are two Bach cantatas, one of

them the sprightly "Wedding Cantata" of which Elizabeth Schumann's H.M.V. performance was one of the joys of former years. The soprano in this up-to-date issue is Anny Felbermayer (PVL 7064). A very interesting Stravinsky coupling gives us the cantata "Les Noces" and the fascinating suite for a small instrumental ensemble, "The Soldier's Tale" both expertly performed under the direction of Mario Rossi (PVL 7009). And for relaxation, there are no fewer than a dozen intoxicating Strauss polkas performed by the Vienna State Opera Orchestra under Anton Paulik, so make a note of PVL 7003.

"Stranger in Paradise" may be heard without vocal embellishment on Decca F 10495, where it is played as tastefully as is everything else, by Mantovani's orchestra, and backed by a number called "The Deserted Ballroom". It is good to see a British singer looking into the charmed circle of hit-makers, as Ruby Murray did here with "Softly, Softly". Here she is again with another hit, "Evermore", which shares Columbia DB 3617 with "Bambino". Another British artist, Barbara Lyon, has done equally well with her recording of "Stowaway" (DB 3619) and its backing is "The Pendulum Song". Always on the lookout for talent from among those who visit our shores, H.M.V. have secured the services of Colin Bailey, the drummer with the Winifred Atwell show. On HR 58 he joins a New Zealand group in "Hallelujah" and "Autumn Leaves". There are also new releases from the lively Bonnie Lou ("Danger, Heartbreak Ahead" and "A Rusty Old Halo", Parlo NZP 21), from the large Ferko String Band ("Alabama Jubilee" and "Sing a Little Melody" on London HL 8140), and Johnny Desmond who is among the first in the field with that fine old Civil war favourite "Yellow Rose of Texas" (DNZ 83). Gisele McKenzie, now on H.M.V., offers "Boston Fancy" and "Hard to Get" on HR 10132, while Slim Whitman's latest coupling, "Haunted Hungry Heart" and "Roll On Silvery Moon", previously on 45, now reaches a wider public with its 78 release on HL 8141. The latest foursome to materialize are the Four Esquites, and they do so with "The Sphinx Won't Tell" and "Three Things" (HL 8152). For the children, there is a batch of Enid Blyton's "Noddy" stories, narrated by the authoress herself on a new H.M.V. series. Eight little stories are contained on four records, the numbers being BD 1296-9. A Vera Lynn "Popular Medley" (Decca Y6736) includes many tunes which have attained popularity recently.

On Philips there are, as usual, some choice and out of the way items. Those who enjoy Morton Gould's orchestral arrangements will make for the two tunes on B 21573, "The White Swan" and "Enchanted". Carmel Quinn is a vocalist of the intimate kind and she has superior material in the "Whistling Gypsy" and "Galway Bay" on B 25611. Doris Day puts vitality into her "Calamity Jane" numbers on B 25612; the titles are "What Am I Doin' in Kansas City" and "Tis Harry I'm Planning to Marry". From England we have Frankie Howerd and Margaret Rutherford, of all unlikely combinations. "Nymphs and Shepherds" is mildly funny on first hearing; its backing, "All's Going Well, My Lady Montmorency" makes use of a rather ancient joke and may appeal to some (P 26076). It's interesting to have a record of the Maori Quartet, a combination who have become popular in variety circles in England. On P 26179 their offerings are the "Moon of Manakoora" and a "Hawaiian Drinking Song". Geraldo is back, this time with his "New Swing Orchestra", and a modern setting of the "British Grenadiers" to show off their paces. On the reverse they revive a "Wizard of Oz" number, the one that proclaims the demise of the witch (P 26173). One of the brightest Latin American songs to appear of late has been "Never Mind de Noise in de Market", which Pete Hanley sings on B 21612. An orchestral novelty from Wally Stott is contained in his coupling of "The Dizzy Duckling" and "Mr. Pastry's Polka" (P. 26185).

The lighter Philips LPs are headed by the second Anna Russell disc, on which she has preserved her classic analysis of Wagner's "Ring", recorded at a performance she gave in New York, hence it is interesting to observe how she varied her text when she "lectured" on this subject while touring New Zealand. It shares the disc with her superb Gilbert and Sullivan take-off and the monologue in which a society lady introduces a celebrated pianist to a women's organization (BBL 7033). Many of us are hoping that Anna will record her own priceless burlesque of pianists' antics: maybe this will come soon. Kostelanetz continues his large-scale operatic fantasias with another release on NBL 5006, the subject this time is "La Traviata". A composite LP entitled "Music for Millions" has a varied collection of numbers recorded by different combinations. The "Nuns' Chorus" from "Casanova" makes a welcome reappearance, as does "Panis Angelicus" and an "Ave Maria" unidentified on the list, though I am sure it will either be Schubert's or Gounod's (BBR 8042).

There are some extraordinarily interesting Philips classics, but one look at the impressive list convinces me of the futility of doing it justice in what little space (if any) is left this month, hence I may be permitted to postpone consideration of this, and of a huge classcal release by the E.M.I. group, untl next tme.

CLEANING:

Emi Sales and Service Ltd., of Hayes, Middlesex, has produced a chemical cleaning fluid which is reputed to dissipate effectively the strong electrical charges which attract dust to the surface of vinyl long-playing records. To ensure that the liquid is sparingly used, it is supplied as an impregnant in a cleaning "cloth" of folded crepe paper which is known as "Emitex". Each cloth will treat an average of 100 record sides.

It has been found that a single application is sufficient to disperse deliberately induced charges which were strong enough to lift the record envelope off the table. Some curious effects were noticed during the cleaning process, due to uneven distribution of the charge, a few particles appearing actually to be repelled by the disc. When the film has penetrated to the bottoms of the grooves, the surface becomes electrically inactive, and this process is usually complete after a single playing. Thereafter, the treatment should not require to be repeated for several months.

According to the makers, the treated surface reduces the friction between stylus and grooves by about 20 per cent.

STRAIGHTENING WARPED RECORDS:

Badly warped records may be straightened by immersing them in hot water (140°–160° F.) in a flat bottom pan about one inch deep. A dinner plate should then be inverted over the record so that its weight is applied only around the outside edge of the record. Add about a pound more weight on top of the dinner plate and leave the record this way until the water has cooled to room temperature. The process should not be rushed for the use of any high-speed cooling methods will result only in the record immediately warping again.

ADDITIONAL PROTECTION FOR LPs.

Since last April, H.M.V. Ltd., of Hayes, Middlesex, England, have been using the American R.C.A. Victor principle in pressing their records. This offers a raised area at the centre and outside edge of the disc, thereby protecting the playing surface from friction at such times as taking the disc in and out of the sleeve, or when an automatic changer is employed.

Development of an Electron Astronomical Telescope

How the enterprise of the Pye Company, together with the astronomers of the Cambridge Observatories, has placed Britain in the lead in exploring the new field of television astronomy, was described by Dr. Peter Fellgett, of the Cambridge Observatories, in a paper read during the Ninth General Assembly of the International Astronomical Union, which met in Dublin last August.

The modern astronomical telescope is fundamentally a light-gathering device, which, in conjunction with photographic methods, has greatly extended the range at which very faint objects, such as the distant galaxies, can be recorded. The giant 200-inch reflecting telescope at Mount Palomar has already photographed galaxies at the range of 2,000,000,000 light years. To achieve this result, an exposure time of one hour was required, using the most suitable photographic plates specially conditioned in order to give optimum results. Owing to the limitations imposed by the background illumination of the sky and the scattering of blue light in the atmosphere, it is unlikely that fainter objects at greater distances can be detected by using an even larger instrument.

The cost of the Mount Palomar telescope was 6,000,000 dollars, and it took twenty years to build. The nature of the engineering problems to be overcome in conjunction with the limitations due to the presence of the earth's atmosphere render improbable the construction of a larger telescope using purely photographic recording methods.

The nature of light is such that sensitive receivers like the human eye or the photographic plate are capable of responding to only a fraction of the light "particles" or photons reaching them—the rest being totally ineffective. For instance, the fraction for a photographic emulsion is about 1/100, and may be as low as 1/1000 for the type of plate used in long astronomical exposures. In the case of the human eye the fraction is of the order of a few hundredths.

The rate of progress in the production of special emulsions for astronomical use during the last fifty years has resulted in a gain of approximately half a stellar magnitude. From this fact, it would appear that any considerable improvement in photographic emulsions is improbable in the near future, and in consequence the exploration of an alternative method of making more effective use of the light-collecting power of existing telescopes is being undertaken at Cambridge.

In 1951, a possible solution to the problem was proposed by Mr. Bruce Somes-Charlton, an amateur astronomer on the staff of Pye Limited. The project involves the development of an electron telescope based on the light storage properties associated with certain types of photoelectric television camera tubes and image storage tubes operating in conjunction with special circuit techniques.

With the approval of the technical director of Pye Limited, Mr. B. J. Edwards, an approach was made to the Cambridge University Observatories with a view to securing advice and co-operation in conducting initial experiments. With the enthusiastic support of Dr. Fellgett, tests were carried out using a new 12-inch horizontal solar tunnel instrument and the 25-inch Newall refractor. The results achieved using substantially normal television equipment were so encouraging that it was decided to proceed at once with the design of more specialized equipment to exploit the possibilities of special tubes produced by Cathodeon Limited, Vacuum Physics Division of the Pye Organization. Photographic images were obtained showing details of the sun's disc in ultra-violet and infra-red light. The solar telescope and spectograph developed by Dr. von Kluber was used, and spectrum phenomena which had never before been viewed directly were observed and recorded; previously, many of the sun's phenomena obtained spectrographically were extremely difficult to photograph without being able to view directly beforehand.

Successful results were also obtained using the Newall refractor for observations on the Moon, Jupiter, and Saturn. The focal images produced by the 25-inch objective were sufficiently large and bright to reveal detail such as the cloud belts on Jupiter and small lunar craters. Comparisons were made with photographs obtained under the same conditions which revealed the advantages of the electronic technique over photography in overcoming the effects of atmospheric tremor.

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PUBLICATIONS RECEIVED

FOR REVIEW:

From Iliffe & Sons Ltd., Dorset House, Stamford St., London, S.E.1.

Television Receiver Servicing, Vol. 2: Receiver and Power Supply Circuits, by E. A. W. Spreadbury, M.Brit.I.R.E.

"Wireless World" Guide to Broadcasting Stations, 1955-56.

TRADE PUBLICATIONS RECEIVED:

From Amalgamated Wireless (Australasia) Ltd.

Aerial, July, 1955.

From Automatic Telephone & Electric Company Ltd.

A.T.E. Journal, Vol. II, No. 3, July, 1955.

From H. W. Clarke & Co. (N.Z.) Ltd.

Westinghouse Engineer, September, 1955.

From National Electrical & Engineering Co. Ltd.

G-E Ham News, Vol. 10, No. 4, July-August, 1955.

From Philips Electrical Industries of N.Z. Ltd.

Electronic Application Bulletin, Vol. 15, No. 11 and 12, November and December, 1954.

Philips Technical Communication, No. 3, 1954.

Philips Technical Review, Vol. 16, No. 7 and 8, January and February, 1955.

V.D.R. (Voltage: Dependent Resistors).

Philips Cold Cathode Tubes; Voltage Stabilizers; Trigger Tubes.

Philips Quartz Crystal Units for Frequency Stabilization.

From Standard Telephone & Cables Pty. Ltd.

Electrical Communication, Vol. 32, No. 2, June, 1955.

GENERAL PUBLICATIONS RECEIVED

Boletin del Centro de Documentacion Cientifica y Tecnica de Mexico, Vol. 4, No. 7.

Break-in, Vol. XXVIII, No. 10, October, 1955.

das elektron, No. 8.

Electrical Industries Export, Vol. 55, No. 9, September, 1955.

Electronic Engineering, Vol. 27, No. 331, September, 1955.

The Gramophone, Vol. XXXIII, No. 388, September, 1955.

N.Z. Electrical Journal, Vol. 28, No. 10, October, 1955.

Radiotronics, Vol. 20, No. 9, September, 1955.

The Radio Constructor, Vol. 9, No. 2, September, 1955.

Radio Electronica, Vol. 3, No. 8, August, 1955.

Radio-Electronics, Vol. XXVI, No. 10, October, 1955.

Service, Vol. 24, No. 9, September, 1955.

Wireless & Electrical Trader, Vol. 99, No. 1295, Advanced Show News, Show Report and Show Review.

Wireless Engineer, Vol. 32, No. 9, September, 1955.

Wireless World, Vol. 61, No. 9, September, 1955.

NO. 5: INTERNAL RESISTANCE OF DRY BATTERIES.

Many users of dry batteries do not realize that the latter have what is known as internal resistance. It would be somewhat surprising if batteries were the only electrical devices not to possess resistance, but the existence of this property is often forgotten, only because it does not show on any circuit diagram. It is never-the-less real, and especially in B batteries of portable receivers, can reach quite high values, and can have a profound effect on the performance of these receivers. In addition, the presence of internal resistance can easily mislead anyone who measures the terminal voltage of a battery, into believing that it is serviceable, whereas, in fact, it has deteriorated to the stage of being quite useless for its intended purpose. It is therefore of some importance that users of dry batteries should be aware of the effects of internal resistance, and of how they can be minimized in the case of B batteries for portable receivers.

At the beginning of a battery's life, its internal resistance is low, and for all practical purposes can be ignored. As the material of the battery is used up, the waste products left behind as the result of the chemical changes which make the electric current available, clog up the conducting paths, and so cause the resistance to increase. The actual value of the internal resistance varies considerably, depending on the make, previous history, and rate of discharge of the battery, and is, of course, proportional to the number of cells of the same kind that are connected in series to make up the battery. Measurements undertaken on a large number of batteries show that the average internal resistance of a 22½ volt section that has been discharged to 12 volts is in the vicinity of 330 ohms. This amounts to 990 ohms for a 67½ volt battery, and 1320 ohms for a 90 volt block.

The most easily observed effect of internal resistance is that it causes the voltage appearing at the battery terminals to vary according to the current that is being drawn from the battery. Now, in a radio receiver, the output valve draws a larger current than any of the other valves, and this varies at an audio frequency rate when the valve is working. This means that the terminal voltage of the battery, and therefore the voltage supplied to every other valve in the set is also varying at the same rate. In some stages, this will cause negative feedback and loss of amplification, but, in others, the feedback will be positive, and when the fluctuation is great enough, it will cause an uncontrollable oscillation to start. This oscillation is usually at a very low frequency, and is what is commonly described as motor-boating. If the designer of a set has not taken the internal resistance of the battery into account, motor-boating may start when the resistance of the battery is as low as 25 to 50 ohms per 22½ volt section.

In practically all cases, an electrolytic condenser across the battery will remove difficulties from motor-boating, but if this solution is used, it is imperative to use an on/off switch which removes the B voltage from the circuit in the off position. Doing so has two useful effects. In the first place, it prevents the leakage of the electrolytic condenser from discharging the battery when it is not in use, and secondly, it prevents certain faults, such as breakdown of transformers, condensers, etc., through electrolysis.

A rough, but sufficient routine test of a B battery, or of any dry battery, for that matter, is to measure its terminal voltage with a high-resistance voltmeter first, without any other load, and then, with the normal load for the battery. If there is only a very slight difference between the two readings, then the internal resistance is low, but if it is pronounced, the resistance is high. This question is such an important one that we propose to devote the next instalment in this series also to it.

FREQUENCIES FOR "RADIO NEW ZEALAND"

From Friday, 2nd December, 1955 (New Zealand date), Radio New Zealand will transmit in accordance with the following frequency schedule:—

(1) TO AUSTRALIA

2000-0600	GMT	ZL19	11.83 Mc/s.	in the 25 metre band.
0615-close down		ZL2	9.54 Mc/s.	in the 31 metre band.

(2) TO PACIFIC ISLANDS

1700-2155	GMT	ZL3	11.78 Mc/s.	in the 25 metre band.
2210-0245	GMT	ZL4	15.28 Mc/s.	in the 19 metre band.
0300-0600	GMT	ZL3	11.78 Mc/s.	in the 25 metre band.
0615-close down		ZL7	6.08 Mc/s.	in the 49 metre band.

Close down is at 1045 GMT on week-days
1120 GMT on Saturday
1000 GMT on Sundays.

News bulletins may be heard at

1800 hours GMT (London News)
1900 hours GMT (London News)
2000 hours GMT (London News)
0033 hours GMT (N.Z. News) Monday to Friday inclusive.
0630 hours GMT (London News)
0830 hours GMT (N.Z. News) Monday to Saturday incl.
1030 hours GMT (N.Z. News) Monday to Saturday incl.

ELECTRICAL AND TRADE SECTION

Good Home Lighting Means Better Vision and Cosier Homes

Houses in which the lighting makes a substantial contribution to greater home comfort are still all too few. Sometimes the proper lighting of a house seems to present a very difficult task, but it is no problem at all with the modern means. Once you have grasped the idea of the dual purpose of home-lighting (better vision and greater cosiness), then you will have come quite a long way. Thanks to modern lighting technique, various means can now be applied in order to attain better vision and to create more cosiness.

In the living-room, in which the family spends most of the time, strong light is required for a variety of widely differing activities. A much more subdued lighting is required, however, for creating the indispensable atmosphere of domestic privacy and intimacy. This inconsistency is efficiently bypassed if, besides a good central light-source, liberal use is made of local lighting. One (central) light-source in a living-room will not suffice: the corners will be shrouded in a sort of twilight so that it is impossible to do any reading, writing, or handiwork without excessive strain to the eyes.

Moreover, if the room is illuminated by one central light-source, all shadows and the surface glow are directed to one side, with the result that the room takes on a monotonous and sometimes even a cheerless character.

If additional lighting is applied, a room seems to grow larger, it assumes a better atmosphere, and there is sufficient light for the various activities. The more or less irregular alternation of light and dark on furniture and walls makes a pleasant variation, which gives a lively and pleasing impression. These extra light-sources also open up more space for movement, since all parts of the room can be used to a greater extent. A reading lamp, one or two standard lamps (on the sideboard, mantelpiece, or table), and a few wall-lights can change the living-room as if by magic and adapt it to changing circumstances. A festive atmosphere can be created, if guests are coming, by turning on all the lights; there is ample light for reading or needlework without the eyes being strained, no matter where the easy-chair is put down; if one wants to have an informal chat or to listen to music, then only a few wall-lights should be switched on in various corners; the strong central lamp must not be turned on, and in this way the appropriate intimate atmosphere is automatically brought about; the corner where the children are playing receives a sufficient amount of light, especially in winter, so that they never need to sit in twilight; school children can then do their homework in a separate corner in good light.

A more decorative lighting can be arranged in the "cosy corner" by means of a wall cornice with fluorescent tube lamps "TL" (colour 32), which give a subdued indirect lighting. A standard lamp on the table and a wall-light on the opposite wall give a local accent which enhances the liveliness of the interior. Also, a pelmet over the casement curtains may be used for atmosphere-creating illumination.

Fig. 1.—A type of interior lighting with various possibilities. In the cluster there are 6 "Argenta" 40 W spherical lamps. The wall cornice contains three 25 W "TL" lamps (colour 32). In the wall light, a 75 W "Argenta" lamp is used, and in the portable lamp a 60 W "Argenta" incandescent lamp.

Fig. 2.—Corner of the room with the dining-table. Direct overhead lighting on the table by means of three 60 W "Argenta" incandescent lamps. A fixture with a 40 W "Argenta" incandescent lamp is fitted to the wall.

The light of the tube lamps must be propagated both upwards and downwards. The wall-cornice consists of a wooden front edge covered with the same wall-paper as that covering the wall. The fitting of just a bare "TL" tube lamp to the wall—even if it is

Fig. 3.—A 100 W incandescent lamp has been screwed into the central fixture of this bedroom. Each of the two reading-lamps holds a 40 W incandescent lamp. Over the basin there is a glass fixture containing a 40 W incandescent lamp. The "plug-in" lamp in the wall socket beside the basin provides a dim light in the room during the night.

screened by a plate of frosted glass—is usually to be rejected on aesthetic grounds.

In other points of the house, too, all kinds of reasonable improvements can be introduced. From the point of view of atmosphere, a clear general lighting is required for the entrance so as to extend a friendly welcome to both occupants and visitors alike. The stairs and hall must have a good general lighting, and one should bear in mind that this will serve the interests of safety when using the stairs—something which is frequently forgotten.

An extra lamp over mirrors or in recesses—e.g., a "Philinea" tubular lamp or a "Colorenta" or "Colorentina" decorative candle lamp—enhances the atmosphere in the house. In the bedroom a restful atmosphere is created by means of diffused lighting.

"Philinea" tubular lamps over the bed, for reading, or on both sides of the wash-basin or dressing-table, will certainly render good service. Special fixtures provided with a built-in cord-switch have been brought out for such 25 w. tubular incandescent lamps; the cord-switch facilitates the operation.

The term "dim lighting" should not exist for the modern housewife, who requires that all domestic activities go smoothly and quickly. For places which are visited only periodically and then for very brief intervals, such as the hall, the cellar, the attic, or the shed, a lamp of a higher wattage will be a great convenience, but will hardly influence the electricity bill. The cost of lighting is determined by the number of watts multiplied by the number of hours; if one of the two is large and the other small, the product will still be small.

In general, the cost of lighting is less than one-tenth of other expenses. So, if one wishes to cut down the expenses as much as possible, it would still be of little use to economise in lighting by replacing—e.g., the 60 W lamps in the cellar, in the well, and in the attic by 25 or 40 W lamps. Moreover, insufficient lighting of these places would be dangerous as well, and a fall from a badly illuminated staircase

Fig. 4.—The dressing-table, too, must be properly illuminated. A "Philinea" tubular lamp (40 W) was mounted over the mirror, and a shop-window lamp 40 W clear) was fitted under a frosted-glass plate on the dressing-table. In this way the face is properly lighted without annoying cast shadows.

may cost you more than ten 100 W incandescent lamps in 10 years.

The lighting in every home can be improved without breaking and rebuilding qualitatively by replacing the clear "Argenta" lamps by milky-white lamps radiating a diffuse light; and quantitatively by replacing the incandescent lamps that are too small, especially those in the fixtures in halls, staircases, attics, toilets, cellars, and sheds by lamps of the recommended wattage.

The following may be cited as examples of recommended correct wattages: Hall, 60 to 100 W; toilet, 60 W; scullery, 75 to 100 W; kitchen, ceiling lamp 100 to 150 W, supplementary kitchen light 60 to 75 W; cellar, 60 to 75 W; corridor, 60 to 100 W; half-cellar (in Holland, knee-deep cellar), 60 to 75 W; bathroom, central lamp 75 to 100 W, mirror lighting 60 to 75 W; attic, 75 to 100 W.

If you compare these recommended values—which will render your home larger, cosier, more comfortable, and safer—with the values of the light-sources often applied in practice, then you will see that it is about time that it was decided once and for all in many homes that economizing in light means an actual saving. Enlarge your home and make it cosy with more and better light!

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

THE ULTIMATE "SAFETY-SAFETY" JUG AND "SAFETY" KETTLE

The results of the constant attention to detail and the emphasis on up-to-date techniques that have always characterized the manufacturers of the popular Ultimate Electrical Appliances, are apparent in the new Ultimate "Safety-Safety" Jug and the new Ultimate "Safety" Kettle.

To a casual glance the new jug may appear to be very similar to the Ultimate "Safeguard" Jug which has proved to be a sales leader; but there are three improvements which must make this jug even more successful than its predecessor.

Firstly, it incorporates the newly-developed ejector element. This is the first New Zealand-made element to employ this principle and it gives positive protection to both element and jug if the jug should boil dry or be switched on without water. The safety cartridge, which is part of the element, ejects the appliance plug **before** any damage can be caused to the highly finished jug body or the long life element.

Secondly, improvements have been made to minimize the risk of boilovers. An anti-turbulence screen in the body and neat steam louvres in the lid, break up the turbulence associated with boiling water, and while not entirely prohibiting boilovers, it greatly reduces them.

Thirdly, colour will be introduced from the January production runs and this fine jug will be available in the following colours: Mottled red, mottled green, black, blue, red.

And finally all the safety and quality features of the older "Safeguard" jug have been included in the new jug. The body is of spun copper heavily chrome plated to a really brilliant finish. The handle and base are cool to the touch and the safety clip to prevent tipping still gives positive protection to adult and toddler alike.

All these improvements have been achieved for a price increase of only 10s. The retail price of the "Safety-Safety" jug is 97s. 6d.

The new Ultimate "Safety" Kettle also is available with the new safety element and from January will be made in the same range of colours as the "Safety-Safety" Jug.

The "Safety" kettle retains all the old sales features; spun copper body heavily plated for beauty and protection, a wide base for safety and moulded parts that are cool to the touch.

With the improved protection given by the new Safety element the Ultimate "Safety" Kettle is a particularly safe and attractive appliance reasonably priced at 99/6.

New cartridges to replace expended cartridges are obtainable from all Ultimate dealers for 3/6.

The new Ultimate "Safety-Safety" Jug ..... 97s. 6d.
The new Ultimate "Safety" Kettle ..... 99s. 6d.
Replacement Plug Ejector Cartridges ..... 3s. 6d.

Manufactured by: Ultimate-Ekco (N.Z.) Co. Ltd., 6-14 Quay Street, Auckland.

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NEECO TRANSFORMERS FOR THE RADIO INDUSTRY

The National Electrical and Engineering Co. Ltd., are pleased to announce the introduction of their Transformers and Chokes, details of which have been made available to the Trade during the past few months.

This material, which is manufactured by Telecommunications Ltd., of Wellington, is of consistent high quality, considerable pains having been taken at all stages of production to ensure that the high standard set initially should be maintained.

The range, which is competitively priced, includes Power, Output, Vibrator, and Step-down Transformers, and Filter Chokes for all replacement applications. Included too are Output Transformers for Mullard and Williamson Amplifiers. The units are attractively packed in individual containers and stocks are held by all eight branches of "National Electrical".

ENGINEERING HIGHLIGHTS IN DOMESTIC APPLIANCES

From the Westinghouse Electric Corporation of America comes news of the development of many interesting electric appliances. These, by the nature of their application, must present an attractive appearance, but back of the sleek exteriors lies much solid engineering.

New Ranges:

Both the new built-in range and the 40-inch range feature larger ovens. The built-in unit has a 24-inch wide opening; the surface-cooking unit has four detachable plug-in heating elements. The 40-inch range unit has a 30-inch oven; this oven has a double thickness of insulation on all sides and a Fiberglas seal around the door, thus providing uniform, efficient heating.

New Tools For House Cleaning:

Two new vacuum cleaners add to the versatility of cleaning devices. One is the new canister-type machine, the other a tiny portable cleaner, called the Porta-Vac. The canister cleaner uses the "Toss-A-Way" disposable bag, which can be removed from the cleaner in an upright position to avoid spillage of dirt, and a new lightweight hose, composed of a vinyl covering over a steel-wire coil. Fans are of the two-stage turbine type, driven at a normal half-load speed of about 17,000 r.p.m. by a ½ h.p. motor. The Porta-Vac is about the size of a portable radio and weighs but seven pounds. It is designed primarily for limited living spaces, or for tasks like cleaning draperies or upholstery where portability is useful. For its size, the Porta-Vac is a powerful

NEWS FROM THE NEW ZEALAND ELECTRONICS INSTITUTE INC.

At a recent meeting of Council of the Institute, the following admissions to membership were approved:
A.M.: Arnold Clifton Stanbury, Christchurch; Denis Bottrell Raymond, Christchurch; Wilfred Ernest Alfred Garrett, Wellington.

A.: Leonard Richard Allen, Christchurch; Clyde Owen Clinton, Christchurch.

The following was transferred from Student to Graduate: Murray George Cowan, Christchurch.

Examinations

At its recent meeting in Christchurch the Council resolved

(a) That the New Zealand Electronics Institute accept its full share of responsibility for encouraging the New Zealand Certificate of Engineering examination.

(b) That Council give consideration in due course to adopting the New Zealand Certificate of Engineering as a qualifying examination for the Institute.

(c) That the Institute does not meanwhile hold internal examinations.

Students

Subscription rates were amended as follows, effective as from 1st June, 1955:

Students over 21, £1 5s.; Students under 21, £1; in each case subject to the usual rebate.

It was further resolved that the normal remittance to branches of 20% of subscriptions received by headquarters should in the case of students be increased to 50%.

These steps were taken as it was felt that a substantial number of new members could be recruited from students of electronics if their subscriptions were lowered, and an endeavour made by the Institute to assist them in the electronic studies in which they were engaged by means of circulars from headquarters and personal encouragement and coaching arranged by branches. It was suggested that assistance might be given by arranging occasional evening meetings at which specialized equipment, to which reference is made in the course under study but which is not readily available to most students, might be demonstrated.

Australia/New Zealand Conference for the Advancement of Science

The 1957 Conference will be held in Dunedin on 16-23 January, 1957, and the Council feels that the Institute should endeavour to find speakers who might be acceptable to the Conference Executive Committee.

Branches are therefore urged to give this matter serious consideration and, if possible, arrange for members to forward a precis of suggested papers to Council.

Wellington Branch Notes

At its November meeting the Wellington Branch enjoyed an interesting lecture given by Mr. Ascroft of the British General Electric Co. Ltd. on the G.E.C. metal cone loudspeaker. Demonstrations of this equipment also assisted members to form an opinion on its quality.

"Patent Law" was the subject of the December lecture, the speaker being Mr. D. A. MacGill, B.Sc., of the Patent Office. Recent changes in the law relating to electronic affairs were brought to the attention of members who were glad of this opportunity to bring themselves up to date on this complicated subject.

Messrs. G. Todd and R. Lambert, technicians in the N.Z.B.S., have been transferred from the Christchurch to the Wellington branch and Mr. K. Green from Dunedin. The Branch also welcomes Mr. W. E. A. Garrett of Eltham, who has joined the Institute with the grade of Associate Member.

NOTES FROM THE N.Z. RADIO-TELEVISION AND ELECTRICAL TRADERS' ASSOCIATION (INC.)

It will be recalled that, at the recent Conference held at Waitomo, a sub-committee was appointed to prepare a factual report on programmes. As a result of the work of this committee, a letter has been sent to the Minister of Broadcasting, Hon. Mr. Algie, pointing out that though the Auckland city and province now carry over one-third of the population of New Zealand, it cannot be said that, on a proportion of listeners and the amount of licence fees paid in Auckland, this province receives an adequate service in relation to other parts of New Zealand.

Questions relating to commercial stations were omitted from the letter as it considered that, as the whole of their expenses should be met out of advertising revenue, no listener therefore pays a fee to entitle him to reception from those stations. The Association, however, expressed on behalf of listeners, concern about the service rendered from National Stations. It considered that, with 1YA being the only station of this nature on the air throughout the day, one of the other stations, either 1XD or 1YC should also be on the air giving an alternative programme, particularly during periods when YA time is occupied with news bulletins, national broadcasts to farmers and school children.

The Association then went on to suggest that consideration be given to placing 1YD or 1YC on the air from 9 a.m. to 10 p.m. every day of the week, providing a programme of music and light entertainment. "1YD," said the letter, "is the preference for the greater coverage in the province. This would avoid any upset in the present programme arrangements of 1YA, and would serve a widening range of listeners who desire to tune their radios to a musical programme at any time of the day."

Under this heading the Association classifies (A) the farming community. Most dairy farmers have radios in their milking sheds and music between 3 and 5 p.m. summer and winter would be a great encouragement to them; (B) Hotels, restaurants, etc., who desire to provide music during meal hours. Surely it must be of interest to the Tourist Department to have a full range of good music available during meal hours? (C) Industrial workers. Many large production units today provide a radio service to their employees throughout the day. Talking on the air must react against the employee's interest in his job, whereas the effect of background music should be an aid to greater production and ensure more contentment amongst staff; (D) Institutions and hospitals. No one will deny that in all hospitals, except in cases of serious illness requiring perfect quiet, radio programmes in the form of light music are comforting as well as an encouragement to patients to get well. "We think also," continued the letter, "of the many returned servicemen who lie in hospitals for years on end, and who, at the present time, have the choice of children's sessions or some serial from 1ZB. Surely these men alone justify a full-day programme on a musical basis."

The letter concludes with the statement that, in the interests of the people who pay their licence fees, the Association feels justified in placing before the Minister the strongest recommendation that Auckland should receive a greater share, not only of radio programmes, but also of increased strength of stations to ensure reception throughout the province.

machine. For example, it can produce a static pressure of 40 inches of water and deliver 30 cubic feet of air per minute under open conditions, compared to 55 inches, and 58 cubic feet for a large tank-type cleaner.

PLANNING THE REPAIR SHOP:

By WILLIAM E. SYKES

What are the most effective methods of tackling the actual repair of equipment?

I strongly favour the "trouble-shooter" technique, wherever the business is large enough to warrant this system. Briefly, it means that your best men are employed, as they should be, in diagnosing the fault and delegating less experienced staff to the job of replacing or substituting components. By this method you ensure that your expert staff are not employed unprofitably in removing faulty units, and doing other work which may well be undertaken by less experienced personnel. The one thing which must be remembered, however, is that the final test and assembly must be supervised by a first-class man. This is vital and any carelessness can lead to very real trouble. If a good man is in charge of this department, all well and good, but make sure this is the case.

The next step is to divide the actual repair section into two parts, the first dealing with the ordinary run of repairs, under expert supervision, and the second the experts' domain, in which the sticky ones are tackled.

What are the essentials for the design of the first section? I suggest benches at least a yard wide, backed by a wood panel on which can be screwed mirrors, or space found to accommodate instruments, and the whole topped by at least one shelf at a sufficient height above the bench to clear the dimensions of the largest chassis likely to be encountered. The height of the actual bench should receive careful consideration to avoid aching backs and general fatigue of the operators.

If it is intended to seat the engineer at his job, the benches should be lower, and it should be remembered that there is a law on the statute book requiring employers to provide a seat for every worker. Though, to date, this law has not been rigidly enforced, it should be borne in mind. In any case, it is only common sense to see that each engineer is working in comfort. Quite apart from your desire to foster his well-being as a member of your staff, he will do his job better.

The matter of floor insulation must receive careful attention, particularly if the floor is concrete. Here a wood covering, topped with a hard-wearing insulating material, is desirable. Quite apart from the question of electrical shocks, some people are very susceptible to concrete floors and complaints such as rheumatism, piles, and cramp, are often started or aggravated by such conditions. Here again it will pay to be civilized. When considering the merits of the flooring purely from the standpoint of shock resistance, we should remember that 235v. A.C. is still lethal, and probably the most dangerous component on the bench. Fortunately, we have heard of very few cases of electrocution in our industry, although from some "set ups" I have seen in the course of my travels, it would appear that this is more due to the active intervention of providence than to any conscious measure of safeguarding. However, the particular method of ensuring a reasonable degree of safety must be left to the discretion of the individual dealer, who, if he is wise, will err on the side of safety.

Of course, the provision of a full range of plugs and multi-plugs on the front of the bench is elementary, and, since we have almost the same lack of sanity displayed by the electrical trade as we have in the multiplicity of valveholders, it would be well to be prepared.

With regard to test instruments, only the more elementary ones should be needed in this section, and I suggest that the making up of a number of high resistance meters for the checking of resistance and voltage could be undertaken with advantage. A reasonably large flush mounting microammeter of 0-50 microamps, together with the necessary components and switch may be fitted conveniently in the back panel of the bench. Probably it is the most useful instrument likely to be needed here.

It would be desirable to fit such an instrument for the use of each engineer on the bench, rather than provide a portable one for general use, as the latter is sure to be needed by several people at once, and the former does not "clutter" up the bench. Other such obvious items as the provision of a good valve-tester and capacity bridge for general use hardly need my comment.

Of course, it is possible to indicate only the general principle of this system of specialized servicing. It works very well on paper, like many other systems, but the practical application will reduce the invariable snags. These, I feel can be overcome, and the bigger the concern involved, the more successfully can the scheme be operated. The smaller the dealer, the more versatile must be the engineer.

(Reprinted from "Wireless and Electrical Trader.")

NEW PUBLICATIONS RECEIVED

GUIDE TO BROADCASTING STATIONS, 1955–56

Compiled by the staff of "Wireless World", Eighth Edition. Published for "Wireless World" by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1. Price 2/6d. plus 2d. postage.

Since the publication of the last edition of "Guide to Broadcasting Stations" there have been a very large number of changes in the operating frequencies of broadcasting stations throughout the world. This fact, together with the number of additional stations now in service, has necessitated a complete revision of the information included in the eighth edition.

All the 650 stations operating on long and medium waves are listed both in order of frequency and geographically. Incidentally, nearly 50 per cent. of the medium-wave broadcasting stations in Europe are operating on frequencies not allocated to them under the international plan drawn up at Copenhagen in 1948. These stations are marked in the frequency list.

Some 1,600 short-wave broadcasting stations of the world operating with a power of not less than one kilowatt are also listed, with their call signs, in order of frequency and geographically.

The information given in the book was secured from many sources and has been checked against measurements made at the B.B.C. receiving centre at Tatsfield, Surrey.

Although of mainly academic interest to listeners and viewers in this country, operating details of Europe's 300 or more v.h.f. broadcasting stations and 130 television transmitter stations are also included.

Another useful feature is the table giving standard time for all countries operating broadcasting stations.

"WIRELESS WORLD" DIARY, 1955

Published by Iliffe & Sons Ltd., Dorset House, Stamford St., London, S.E.1. Price, leather 5s. 10d., rexine 4s. 1d.; postage 2d.

The answer to 101 technical and organizational questions will be found in the reference section in the "Wireless World" Diary, now in its 38th year of publication. Base connections for 600 current valves, graphical design data and a directory of radio organizations in Britain and abroad are included in the diary, which provides in tabloid form the kind of technical and general information frequently required by the radio man but seldom readily available.

Contents include: Abacs; Abbreviations; Addresses of Radio Organizations; Aerials, S.W. and V.H.F.; Air-Cored A.F. Chokes; Amateur Transmission; B.A. Screws and Drill Sizes; Binary Code; Circuit Diagrams; Coil Winding Data; Component Coding; Conversion Table; Decibel Equivalents; Design Data; Electrical and Magnetic Units; Electrical Interference Supression; Formulae; Greek Alphabet; Insulants and Dielectrics; International Prefixes; International Organizations; Licence Regulations; Mathematical Signs; Modulation Classification; Morse Code; Postal Rates; Resistor and Capacitor Coding; Resistor Ratings; Resistors in Parallel; Standard Frequencies; Symbols; Television Attenuators and Splitting Circuits; Television Channels; V.H.F. Broadcasting; Valve Base Connections; Waveband Classification; Weights and Measures; Wire Tables; Wood Screws.

TELEVISION RECEIVER SERVICING

VOL. II: RECEIVER AND POWER SUPPLY CIRCUITS

(By E. A. W. Spreadbury, M.Brit.I.R.E. Published by Trader Publishing Co. Ltd., and distributed by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S. E. 1. Price 21s. Postage 8d.)

This is the second volume of a comprehensive book written specially for radio service engineers who wish to obtain a thorough knowledge of television servicing work. It assumes that the reader already has a reasonably good grasp of the principles of radio servicing, and it extends these to television's more complex circuits and techniques.

The first volume covers the time-bases and their associated circuits only. This second volume deals with all the other sections of the modern receiver, including the video stage, tuning circuits, sound channel, power supplies and aerial arrangements. Attention is also paid to such matters as vision interference suppression, the various multi-channel tuning systems now in use, vision automatic gain control, and the problem of reflections and "ghosting". A final chapter gives much valuable information on the technique of circuit alignment.

The text is presented in a practical and straight-forward manner, and the numerous illustrations include a wide variety of actual circuits, each of which is discussed in detail.

THE USE OF ELECTRONICS IN MEASUREMENT

The name "electronics" indicates the functional basis of most of the radio devices which can be applied to the various kinds of instruments, namely, thermionic valve, cathode ray tubes, certain types of photocell and similar apparatus. It is advantageous at the outset to examine the criticisms and alleged disadvantages of equipment and instruments incorporating such components, because they have tended to limit their use in the past, both by users in the heavier electrical engineering branches and in the non-electrical fields of application.

These criticisms have been mainly:—

(i) That such electronic instruments and equipment are bulky, fragile and require careful handling, especially since some of the most important components are housed in glass envelopes.

(ii) That thermionic valves of any type can vary considerably from their normal performance, and thus are unsuitable for exact measurement purposes, and involve difficulties in maintenance and replacement.

(iii) That all electronic equipment requires external power supplies. When batteries are used, they are bulky and require frequent replacement and adjustment; when the equipment is to be operated from the electricity supply mains, there is the encumbrance of trailing leads and the necessity of dealing with the many types of supply throughout the world.

(iv) That engineers skilled in the theory and practice of electronics are required to operate such equipment, which obviously would present difficulties to non-electrical industries.

Most of these criticisms can be met by consideration of experience obtained during the war. Every fighting ship, aeroplane and land vehicle contained radio and radar equipment of greater complexity than the majority of existing or projected electronic instruments. Due to the prevailing man power shortage, the war time radio and radar apparatus was operated and kept in running order by men and women who generally had no previous experience and limited training. Moreover, recently it has been disclosed that many of the operating mechanisms in bombs, rockets and even shells were based on the use of thermionic valve equipment and associated power supplies built into these weapons. Perhaps the best example is the proximity fuse built into the extremely small space in the nose of an A.A. Shell. This is, in essence, an electronic instrument for the identification of a predetermined distance between bodies, one of which is moving.

While the thermionic valve can be used satisfactorily and reliably in war time conditions of extremely short operating life, it can also be used continuously in totally inaccessible positions for many years, as in the case of the underwater repeater for telephone cables, which operates at the bottom of the ocean.

Since these thermionic valve-operated equipments have withstood the shock of bomb and shell, and have been used in all parts of the world under the worst terrestrial conditions, it is safe to assume that they will operate satisfactorily in ordinary industrial conditions, or even in the hands of farmer, miner, doctor or housewife, if they should achieve such universal use.

INSTALLATION MEASURES

Permanent electronic equipment, whether in a laboratory or in a non-technical environment, should be installed in strict accordance with the Electrical Code and any applicable fire department rules and regulations as applied to wiring.

Some of the pitfalls to be avoided include: dangling, trailing, draped, or frayed power cords; overloaded power outlets; overheated or damp locations; overloaded power switches; unfused power lines or lack of circuit breakers; and use of multiple attachments (cube taps).

Provide a safety ground at every installation. This consists of connecting together with a heavy wire all of the metal panels, chassis, racks, cabinets, etc., and running this wire directly **to a good ground.** In most cases, the grounded electrical conduit is an adequate path to ground. But, as an added guarantee, use a good earth ground consisting of a cold-water pipe or a long pipe driven into moist soil. Three-wire cords, with the wire connected to the electrical conduit, are handy because they connect the equipment automatically to ground whenever the power plug is inserted into the outlet.

In some places, three-wire power cords are mandatory in industrial installations, but the rule often is not enforced in laboratories unless there have been hazardous situations or serious accidents on record. Where three-wire safety outlets are provided in a building, do not fall into the habit of inserting two-prong plugs. Take full advantage of the safety provided, by replacing the two-prong with three-prong plugs.

Many commercial electronic instruments have a grounding pigtail on the end of their power plugs. Signal generators, vacuum-tube voltmeters, amplifiers, oscilloscopes, and tube testers are among the familiar devices so equipped. Do not clip these leads. Use them for the safety-grounding purposes for which they were supplied.

Place "DANGER—HIGH VOLTAGE" signs conspicuously both outside and inside the equipment at all important points where an operator needs to be reminded of the hazard.

Mount an approved fire extinguisher near the equipment. Carbon dioxide extinguishers are desirable for electronic equipment fires, since they usually do not cause any chemical or moisture damage.

A proposed location for a stationary electronic installation should be surveyed beforehand with respect to favourable temperature, humidity, vibration, power-line stability, magnetic fields, and traffic conditions to determine which elements should be removed or modified in the interest of safe operation.

FAILURE v. SAFETY

Electronic equipment breaks down in spite of the best engineering and maintenance. Failure is considered as falling into two categories. When the break-

down of a component causes dangerous overloads or voltage peaks, or places high potentials in undesirable places, the failure is said to be **unsafe.** When breakdown places the system out of operation without in any way introducing trouble in the system or to the operator, the failure is said to be **safe.**

No blanket rule can be stated for designation of all cases. A particular failure must be viewed in terms of an analysis of the circuit or system in which it occurs, in order to determine into which category it falls. Consider these examples: A bleeder resistor in a power supply fails unsafe because in burning open it allows a dangerous charge to be held by the filter capacitors. A short-circuited filter capacitor also fails unsafe because it draws excessive current which may destroy the rectifier (producing much heat), filter choke, or transformer. An open-circuited secondary winding in a power transformer in a simple power supply fails unsafe because it removes the power automatically from the entire system. But the secondary would fail unsafe if the power supply furnished fixed bias voltage to high-power tubes, since these tubes would draw excessive plate current in absence of the bias.

The cautious designer of electronic equipment will take every possible precaution to favour fail-safe operation. For example, the inclusion of a fuse in series with a filter capacitor will change a fail-unsafe probability into a fail-safe situation, since the fuse will open if the capacitor short-circuits.

The question of power supplies is becoming simplified by the standardizing of A.C. mains voltage and frequency, and, where batteries are required, recent developments have resulted in a great reduction in battery size with improvements in stability, capacity and life. Where necessary, portable instruments now can be used to operate from either mains or batteries without undue increase in size or weight.

With regard to the possibilities of the use of the thermionic valve as a precision component for measurement purposes, great advances have been made during the past ten years, largely as a result of the development of feedback circuits and other devices which result in high stability amplifiers which are largely independent of the actual characteristics of individual valves. Also, extensive research and development work is being carried out constantly by makers of thermionic valves, both in the design and performance of the individual valve and its applications to all types of circuit, so that especially stringent requirements often can be met by close co-operation between the equipment designer and the valve manufacturer.

(Reprinted from "G.E.C. Journal," Vol. XIV, No. 3)

"R & E" TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in. 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

CANADIAN TRADE SHOWS, JANUARY–JUNE, 1956

A list of the principal Canadian Trade Shows held from January to June, 1956.

Furniture Show.—Exhibition Park, Toronto, January 9-18, 1956. For information: C. L. Stark, 57 Bloor St., W., Toronto.

Eastern Canada Hardware Show.—Show Mart, Montreal, January 23-26, 1956. For information: Eastern Canada Exhibitions Inc., 423 Ontario St. E., Montreal.

Ontario Retail Farm Equipment Dealers' Association.—Exhibition Park, Toronto, January 24-27, 1956. For information: L. Sykes, 40 Wellesley St., E., Toronto.

Hotel and Restaurant Suppliers' Exhibition.—Show Mart, Montreal, January 31-February 3, 1956. For information: R. Pelletier, Hotel and Restaurant Suppliers' Association, 1638 Sherbrooke St. West, Montreal.

Canadian Refrigeration Manufacturers' Assoc.—Exhibition Park, Toronto, February 1-3, 1956. For information: H. S. Parish, 137 Wellington St. W., Toronto.

Canadian Hardware and Housewares Exhibition.—Exhibition Park, Toronto, February 6-9, 1956. For information: R. M. Gilmour, Canadian Retail Hardware Assoc., 290 Merton St., Toronto.

Agricultural Show.—Show Mart, Montreal, February 17-26, 1956. For information: Gabriel Renaud, Exposition Agricole, Inc., 152 Notre Dame St. E., Montreal.

Canadian Sporting Goods and Cycle Association Merchandising Show.—Queens Hotel, Montreal, February 19-23, 1956. For information: P. J. Wardle, Canadian Sporting Goods and Cycle Association, Suite 604, 80 Richmond St. W., Toronto.

National Gift Show.—Exhibition Park, Toronto, February 20-23, 1956. For information: Angus Baxter, 9 Duke St., Toronto.

Canadian Toy Fair.—Mount Royal Hotel, Montreal, February 27-March 2, 1956. For information: W. J. Cannon, Canadian Playthings Manufacturers Inc., 55 York St., Toronto.

Canadian Toy Importers Association Toy Fair.—Queens Hotel, Montreal, February 27-March 2, 1956. For information: W. S. Thomson, 27 Wellington St. W., Toronto.

Canadian National Plastic Exposition.—Exhibition Park, Toronto, March 5-7, 1956. For information: B. Danson, 26 Queen St. E., Toronto.

Montreal Gift Show.—Show Mart, Montreal, March 5-8, 1956. For information: Show Merchandising Ltd., 9 Duke St., Toronto.

Canadian National Sportsmen's Show.—Exhibition Park, Toronto, March 9-17, 1956. For information: L. M. Kelly, 85 King St. E., Toronto.

Oil Heating Association.—Exhibition Park, Toronto, March 19-21, 1956. For information: A. V. Rowe-Sleeman, 19 Richmond St. W., Toronto.

National Home Show.—Exhibition Park, Toronto, March 30-April 7, 1956. For information: G. Smedmor, 745 Mt. Pleasant Rd., Toronto.

Exporama, 1956.—Show Mart, Montreal, April 5-15, 1956. For information: Robert Letendre, Chambre de Commerce du District de Montreal, 14 St. James St., E., Montreal.

Canadian Restaurant Association.—Exhibition Park, Toronto, April 16-19, 1956. For information: D. G. Adamson, 410 Bloor St., W., Toronto.

Better Home Builders Show.—Show Mart, Montreal, April 23-28, 1956. For information: Eastern Canada Exhibitions Inc., 423 Ontario St. East., Montreal.

Compiled by the Information Branch, Department of Trade and Commerce, Ottawa.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

TRADE WINDS

CANDLELIGHT SOCIAL

On Friday, 18th November last, the 15-Year Club of Ultimate-Ekco (N.Z.) Co. Ltd., held its first social in the company's cafeteria. A splendid evening of dancing, competition, entertainment, and reminiscence was enjoyed by all.

The cafeteria was very tastefully decorated and was lit by candles which gave a novel effect. Thirty-five of the fifty members of the club answered the roll call by the Managing Director, Mr. D. T. Clifton-Lewis who announced that the aggregate service of the club members was no less than 1024 years. Mr. Clifton-Lewis gave a brief and bright summary of the birthday of the company for the benefit of the wives who were present, and expressed the confidence that was felt by all in view of the new association with Messrs. E. K. Cole Ltd., of England.

A fine team of artists entertained and made a solid contribution to the overall success of the evening. Supper and refreshments met every demand and all felt that next year's function will be eagerly anticipated.

Much credit must go to the club committee and to members of the company's social club committee for the splendid work they achieved.

* * * *

PHILIPS AND COLUMBIA, U.S.A.

Mr. L. Lord, managing director of Philips Electrical Industries of New Zealand Ltd., announced that in view of the very rapidly growing importance and volume of the Philips record repertoire—which in America is identical with the Epic label—it has been decided that Philips in New Zealand will in future concentrate on the development and expansion of its own catalogue. As a result, the American Columbia part of the Philips library will, by amicable arrangement with Columbia Records Inc., be segregated from the Philips library proper, to take effect as from January 1, 1956.

Columbia Records, U.S.A., are making their own arrangements in regard to the pressing and marketing of their releases under a new label in New Zealand.

The worldwide co-operation and exchange between Philips and Columbia, U.S.A., will continue and be further intensified.

Suitable arrangements have been made between Philips and Columbia to ensure that there will be no interruption in supply, and to avoid any confusion and duplication on retail shelves.

Records released by Philips in the past will continue to be available also after January 1, 1956.

"Philips intend shortly to communicate to their trade friends and to the public, details of their comprehensive plans for the future which will contain many a pleasant surprise for both trade and listeners," said Mr. Lord.

DECCA TO FESTIVAL

G. A. Wooller & Co. Ltd., Auckland, sole New Zealand Distributors of Festival records, have received advice that as from the 1st January, 1956, the whole of the Decca U.S.A. Catalogue goes to Festival, who will issue these discs under Festival label.

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DEVELOPMENT OF PYE INTERESTS IN AUSTRALASIA

Pye Limited, Cambridge, England, has provided further evidence of its intentions to develop its interests in Australia and New Zealand, by inviting Mr. G. A. Wooller of Auckland to join the main Board of Directors specifically to represent, at Board level, the parent company's interests in these countries. Mr. Wooller thus becomes the first overseas member of the Board. He is already chairman and managing director of Pye New Zealand Ltd., Auckland, and of G. A. Wooller and Co. Ltd., Auckland, as well as director of Akrad Radio Corporation Ltd., Waihi, and Green and Cooper Ltd., Wellington, two Pye subsidiaries.

At the same time Pye are expanding in Australia where Mr. Wooller has been appointed chairman of Pye Pty. Ltd., Melbourne, manufacturers of communications equipment, etc. In Sydney, Pye Limited have acquired a controlling interest in Tecnico Ltd., a £1 million public company manufacturing and distributing vacuum cleaners, floor polishers, electric and motor mowers, tape recorders, etc. At the extensive plant at Marrickville, Sydney, Pye plan to increase the output of present Tecnico television and radio receivers. Pye TV and radio sets will also be manufactured here. Mr. Wooller has been appointed a director of this company and of two subsidiaries—Bendix-Tecnico Pty. Ltd., New South Wales., and F. W. Davey and Co. Pty. Ltd., Victoria. Bendix-Tecnico manufactures aircraft accessories including generators, control panels and relays for Canberra bombers, Sabre fighters, Wingeel trainers for the R.A.A.F and R.A.N. and spare parts for modern civil and military aircraft. Bendix-Tecnico also maintains a servicing organization for all types of units for the R.A.A.F., R.A.N., and civil airline operators. F. W. Davey manufacture and distribute shallow and deep-well water pumps, welders, repulsion induction motors, D.C. motors and generators and D.C. and A.C. lighting plants.

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AVCO AUSTRALIAN EXPANSION

J. N. Kirby Licensed

The James N. Kirby organization, Sydney, has enlarged its association with the £100-million Avco Manufacturing Corporation, U.S.A. Mr. G. A. Wooller of Auckland, director of James N. Kirby (New Zealand) Ltd., has just returned from Sydney where agreements were signed by Mr. James N. Kirby and Mr. Harvey Williams, vice-president of Avco's international division.

(Continued on page 52)

INDUSTRIAL TELEVISION AIDS BRITAIN'S ATOMIC SCIENTISTS

How to obtain information on conditions in a reactor which has been in service for some years. This was a problem which recently faced Britain's atomic scientists of the United Kingdom Atomic Energy Authority at the Windscule plutonium factory at Sellafield, Cumberland. Direct observation was an impossibility owing to the intense radio-activity, even when the reactor was shut down for maintenance. An industrial television camera, suitably protected, provided the answer. Its small size —5¼ x 4 x 11⅜ in.—enabled it to be inserted through a narrow conduit to the interior of the reactor, whence it televised pictures over a closed circuit to monitoring equipment installed at a safe distance. This installation enabled Britain's atomic scientists to study the exact conditions obtaining in the reactor.

Another example of how industrial television is providing invaluable visual information on the conditions of plant and in a manner impossible to obtain satisfactorily by means of human agency is that of the recent installation by the British Electricity Authority at their new power station, Willington "A", in Derbyshire. The equipment overcame two major problems. One, the virtual impossibility of knowing exactly what was going on inside the furnace itself; the other, how best to effect a constant supervision of the boiler water-level. The fuel used for heating the boilers is pulverized coal, which is jet-injected into the furnace with the air stream and is ignited by pilot oil-burners, the latter being extinguished as soon as full combustion has taken place. In such an operation, it is vital to ascertain that the fuel has fully ignited, as a firing failure, if unobserved could result in a serious explosion. In the past, observation has had to be maintained through inspection ports in the wall of the furnace, a procedure which makes supervision difficult in modern stations where control is exercised from a point which may not be immediately adjacent to the boiler. Experiments were carried out with an industrial television camera, fitted with a special air-and-water-cooled lens, and installed in the explosion door aperture at the base of the boiler. The industrial television control unit and monitors were placed at a convenient point alongside the combined boiler and turbine control panel. The experiment was successful, the B.E.A. engineers being able to follow, at the control panel, all phases of the boiler ignition procedure and to detect conditions of imperfect combustion within the area under observation. The second experiment concerned the relatively straightforward operation of monitoring the boiler water-level gauge. For mechanical reasons, this gauge is normally located high up near the top of the boiler, but in spite of this a constant watch has to be maintained upon it, as a lowering of the water-level beyond a critical point would have serious consequences to the boiler. The camera for the experiment was fixed at a strategic point, televising the image of the water-gauge to the monitors at the boiler and turbine control panel. One particularly admirable feature of this application of industrial television is that, unlike all previous electrical alarm devices which have been tried, the television equipment monitors itself for faults. The presence of the picture on the monitor is absolute proof that the equipment is working, in contrast with conventional alarm devices, where the absence of a warning is not itself wholly conclusive evidence that all is well.

Missing and Stolen Radios

AUCKLAND:

Westco American radio in khaki-covered steel cabinet 16 in. x 15 in. x 8 in., with two tuning knobs. American stations marked on dial.

Arnrite 4-valve, battery, portable radio, made in U.S.A. Pale green or pale blue cabinet with fixed plastic handle and two tuning knobs. Dial numbers marked in kilocycles. Back screwed on battery tray of aluminium is slightly corroded. O.P. transformer has soldered joint.

Autocrat 5-valve, 6-volt, auto radio, serial No. 23522 stamped on metal plate screwed to back of set. Golden-brown coloured cabinet with chromium front escutcheon and one gold trimmed control knob on either side of dial.

Pacemaker battery/electric portable, serial No. 38793, blue plastic cabinet.

Autocrat 8-valve auto-radio, serial No. 7333; grey speaker approximately 12 in. x 12 in. x 6 in.

HAMILTON:

Clipper 5-valve, 6-volt car radio, serial No. 66988.

MATAMATA:

Pye radio, serial No. 60530.

WELLINGTON:

Bell broadcast, mantel radio, chassis number 15091, in white plastic cabinet.

H.M.V. battery/electric portable, serial No. 4222, white plastic cabinet 10 in. x 9 in. with bronze grille and imitation crocodile handle.

Columbus 5-valve, battery/electric portable. Red rexine-covered wooden cabinet 14 in. x 10 in., steel carrying handle. Green-coloured oval tuning dial on top.

Two Lynks, 5-valve, battery portable radios, serial numbers any of the following 54010, 54105, 54066, 54071. One has grey and the other maroon oblong dial on rexine-covered steel cabinet 10 in. x 6½ in. x 4½ in., with bakelite front and rear cover plates, leather carrying handles and two white tuning knobs.

Golden Knight 6-valve car radio of American manufacture. Volume control defective in that set reaches full volume as soon as switched on.

Aristocrat car radio, serial No. R. 1302; metal case, grey dial and white tuning knobs.

Philco portable broadcast radio, model 354, number W.17176 written on chassis in pencil and No. 37889 stencilled on chassis. Brown wooden cabinet with brown wooden sliding cover for dial.

LOWER HUTT:

Cromwell, 4-valve, broadcast radio, 5 years' old. Brown bakelite cabinet 8 in. x 6 in. x 10 in.

DUNEDIN:

Pacemaker AC/DC portable radio, model 517aB. Brown leather cabinet 12 in. x 9 in. x 6 in. with volume and tuning knobs on top on both sides of carrying handle.

WAIKOWHAI:

S.T.C. 5-valve portable radio in brown leather cabinet 12 in. x 10 in. x 8 in. Dial and two knobs under lid which was under carrying handle.

Takapuna:

Bell 5-valve, broadcast, mantel model, serial No. 6605; white plastic cabinet with three knobs, oblong dial; red paint spots on top of cabinet.

Philco 6-volt D.W., serial No. 89600.

Putaruru:

H.M.V. Radiomobile, serial No. 40603, chromium and black cabinet; vibrator unit 16 in. x 9 in., painted black.

Christchurch:

Pye 5-valve battery/electric portable radio, serial No. X33467, with broken main switch on side. Red plastic cabinet 12 in. x 8 in. x 6 in., cracked where handle attached; four white control knobs.

Ariel, 7, 6-volt, single unit auto radio, serial No. 3487.

ELECTRONICS IN MEDICINE

THE IMAGE AMPLIFIER

Now in general production in the U.S.A. a fluoroscope with a screen brightness over 200 times greater than that of a conventional fluoroscope, is greatly increasing doctors' ability to diagnose disorders. This Fluorex image amplifier has also been used to enable doctors to extract objects swallowed or inhaled, while watching the progress of the bronchoscope and its contact with the object. In cases of diagnosis of heart malfunction, the physician has been able to follow visually the progress of a catheter into the heart. The image amplifier is also immensely helpful when taking X-ray pictures. It can be used to ensure that film is in the optimum position to show the portion in question. This saves both time and film, and eliminates the necessity of exposing the patient to additional radiation. By the use of the recently developed double-view mirror, the fluoroscope image can be seen by two people simultaneously, which is very helpful in instruction, in consultation, and in those clinical situations requiring teamwork by a surgeon and radiologist.

Using the extraordinarily ingenious optical system fitted to this image amplifier, the physician does not have to look directly into the fluoroscope screen, which conventionally is in a fixed position with respect to the patient. He can fluoroscope either with the patient lying on the X-ray table or standing with back to it, adopting whichever position is most convenient. The viewing mirror, on a universal joint, can be tilted to any angle. Dimensions are such that the physician can easily manipulate the organs while comfortably watching the resultant image.

An automatic brightness control is an important adjunct. A photo-multiplier scans the image, and, by controlling the X-ray tube current, holds the brightness to the value set by the fluoroscopist even though he moves the unit over different thicknesses of the body. In addition to holding brightness constant, it automatically ensures that the patient and fluoroscopist will not be exposed to any more radiation than is necessary to obtain the desired X-ray image.

The brightness of the Fluorex image offers obvious possibilities for motion pictures of functioning organs, or of the passage of tracing dyes through, say, the heart. This desirable extension of usefulness of the image amplifier, however, requires considerable engineering development before it can be made a routine tool.

DISTRACTION ANAESTHESIA

The ever versatile tape recorder, because of its ability to supply uninterrupted music for lengthy periods when needed, has been used recently during a demonstration of "distraction anaesthesia". The demonstrator claimed that the use of music supplied by headphones to the patient materially reduced the amount of anaesthetic required, and the work of the surgeon or dentist was made much easier because of the greater relaxation of the patient.

THE "CALL NURSE" SYSTEM

Successfully installed in several British hospitals, the new "call nurse" system provides each bed with a hand unit for two-way conversation. It is linked to a control point in the ward sister's office or the duty room.

Momentary pressure on the patient's call button sets in operation a buzzer and bed identification lighter. The control unit has a translucent panel on which is engraved a plan of the beds. Lights behind the panel indicate the bed from which the call is being made, and both light and buzzer continue until the call is answered. A single switch enables a nurse to answer any patient, connection to the correct unit being automatic. Volume control is such that both can hear comfortably without disturbing other patients.

Made in compact moulded rubber casing, the patients' units can be cleaned and disinfected easily. Amongst the advantages of this new system are the provision of rapid communication, the avoidance of unnecessary journeys to and from patients, relief of pressure on nursing staff, the provision of an additional safeguard for dangerously ill patients and the greater confidence it gives to patients.

THE "CYTOANALYZER"

Being developed in experimental form by the Airborne Instruments Laboratory in co-operation with the American Cancer Society and the United States Public Health Service, the "Cytoanalyzer" is an optical electronic device which may soon enable cancer cells to be distinguished from normal cells. It uses basic television techniques, with the TV camera viewing slide specimens through a microscope and transforming the picture into an electric signal. A computor then distinguishes between normal and cancer cells.

Four characteristics of cells are now measured by the "Cytoanalyzer"—colour, size, diameter of nucleus and optical density of the nucleus.

R.C.A. COLOUR TV FOR MEDICAL USE

At an exhibition sponsored by the National Academy of Sciences in Washington, D.C., R.C.A. recently demonstrated its new colour TV system in which the compact camera uses three Vidicon pick-up tubes. This is the first compatible colour TV system designed specifically for medical use.

The tubes (one each for the red, green and blue primary colours) are arranged in a vertical array within the camera. A system of dichroic mirrors divide the light from the televized scene into three separate colours. The camera is focussed remotely by a small reversible motor which moves the entire Vidicon assembly.

The compatibility of this system makes it possible to televize information in colour from the operating room or the medical laboratory to doctors and research workers across the country by commercial broadcast as readily as over a closed circuit. The compactness of the camera permits televising surgical operations. A simple lens fitting converts the camera for use with a microscope.

SLEEP INDICATOR

J. S. Fielden (Devon) Ltd., makers of projection TV receivers and associated equipment, have developed an electronic device for gauging the depth of "sleep" or unconsciousness, which is likely to prove most useful for medical purposes.

Using only three valves, the unit works on the accepted theory that the resistance of the skin varies with the degree of consciousness. Already it is being used by a number of hospitals in the operating theatres where the amount of anaesthetic applied to a patient has to be carefully controlled. In fact, the device can be coupled to the administering apparatus.

NEW PHYSIOLOGICAL MONITOR ASSISTS DOCTORS

From our American contemporary journal, "Radio and Television News," August, 1954, we learn of a spectacular development in the electronic field—the construction of an instrument which automatically detects changes in the physiological condition of a patient on the operating table. By use of this equipment, known as the "Physiological Monitor," it is now possible to measure changes in a patient's blood, heartbeat and respiration as they occur and have this information indicated on a panel for interpretation by surgeon or anesthetist.

In the instrument, a microphone is located at the point of observation over the brachial (upper arm) artery. Every three minutes a valve of an air supply automatically opens, allowing the pressure within the arm band to increase. As soon as the pressure in the band exceeds the diastolic value (heart expansion) the microphone begins to pick up sound within the artery. This sound reaches a maximum and decreases, disappearing after the pressure in the band exceeds the systolic point (heart's contraction). By means of a system of amplifiers and relays, the pulses picked up in the microphone actuate two solenoid valves in the air system which open to connect the system to the proper pressure-indicating gauges at the diastolic and systolic points. The valves close almost immediately after opening so that the contracting and expanding pressures, now converted by a transducer to electrical signals remain registered on indicating meters until a new measurement cycle begins.

The amplifier and relay circuit were said to be arranged in such a way that when the microphone receives the initial sound from the artery, the first valve opens, permitting the adjacent gauge to register the expansion pressure. Since it is not possible to determine the point at which sound disappears until that point has been passed, the pressure is therefore carried beyond the contracting point and allowed to decrease slowly until the contracting pressure is reached again. The microphone-amplifier combination selects sound pulses of the required amplitude and frequency content, and converts them into electrical pulses of uniform amplitude and duration to actuate the relay and control circuits. Because the sound originating in the artery is considerably attenuated by the time it emerges from the tissues, the mike-amplifier circuit must be quite sensitive to low-amplitude pulses. At the same time it must minimize unwanted signals originating from microphone frictional noises and random sounds in the immediate vicinity. By improvement of the microphone, by shaping the amplifier passband characteristics to the restricted band of signals, and by development of special coincidence and verification circuits, it was found possible to construct a sensing device which sharply outlines the end points and is virtually undisturbed by spurious signals.

A crystal microphone with a good response at the lower audio frequencies was incorporated into a standard stethoscope chest piece. The mike is thoroughly shielded to keep electrical

(Continued on page 52)

LATEST OVERSEAS DEVELOPMENTS

NEW MODEL 666 SUPER-CARDIOID MICROPHONE

Electro-voice has introduced potentially the most important single microphone in the broadcast and TV field, the new model 666 Super-Cardioid Microphone.

The 666 Super-Cardioid incorporates a new principle of acoustic design, which results in high and uniform discrimination against sound impinging on the back hemisphere, resistance to shock, wider range, greater sensitivity and virtually no proximity effect.

The 666 is 7½ in. long, 1⅝ in. at its largest diameter and 1 in. at its smallest diameter. The microphone is supplied with an intergrated blast filter and magnetic shield and weighs only 11 ounces. Accessories for use with this model include a small, heavy cast stand and an inconspicuous shock mount for boom work.

For further details, write to the Electro-voice Export Managers, Rocke International Corporation, 13 East 40th Street, New York 16, N.Y., U.S.A.

EXTRA PRECISION AUDIOTAPE

Audio Devices, Inc. has announced its new Extra Precision Audiotape, which is specially produced from the most carefully selected materials and ingredients, to meet the most exacting requirements for uniformity and freedom from microscopic imperfections.

Extra Precision Audiotape contributes greatly to the dependable operation of magnetic data recording equipment, where performance requirements are far more exacting than in any field of professional sound recording, such as in data recording telemetering, electronic computers and other specialized applications.

Extra Precision Audiotape is available on 1-½ mil. cellulose acetate base or 1, 1-½, and 2 mil. Mylar polyester film.

For further details, write directly to the Audio Devices Export Department, 13 East 40th Street, New York 16, N.Y., U.S.A.

ACCURATE MEASUREMENT OF SHAFT SPEED NEW PLESSEY TACHOMETER

In many engineering applications, it is necessary to know the speed of a rotating shaft to a very high degree of accuracy. The designers of jet engines, for example, must be able to measure small changes in rotor speed in order to plot accurate thrust and fuel consumption graphs.

Several attempts have been made to produce suitable instruments for this purpose. In the laboratory, modified Maxwell electrical bridges can give accuracies as high as 0.5% by measuring the frequency of the current produced by an alternator coupled to the shaft, and integrating R.C. frequency meters have been used to give direct reading instruments of 1 to 2% accuracy. Direct reading electro-tachometers of the magnetic-drag cup type have also been developed which give readings within 0.5% at the top end of the scale, but are subject to ageing effects of the hairspring and magnetic system.

The latest instrument, which has an accuracy of better than 0.1% at all speeds, is an electronic precision engine speed indicator made by The Plessey Company Limited. The tachometer, which gives an accurate direct reading, is portable and extremely versatile. It will find applications in many fields of engineering and is ideal for use as a standard when calibrating other instruments.

To operate the indicator, the rotary motion of the shaft is converted into electrical pulses. This may be done in a number of ways: aero engines are usually equipped with a small electric generator used in conjunction with the normal magnetic-drag tachometer, and the output from the generator can be used to control a frequency multiplier unit. For engines not fitted with such a generator, a photo-electric device, which imposes no load on the shaft to which it is attached, has been specially developed. It consists of a photo-cell amplifier with an associated opaque disc having 60, 30 and 10 equally spaced slots. The disc is attached to a synchronous motor driven by the aircraft tachogenerator, and when the 60 slot spacing is selected the instrument reading is direct in r.p.m.

The instrument counts the number of pulses generated during a period of one, two or four seconds and gives the result in terms of revolutions per minute on a dekatron display unit. Normally, the pulses are counted for one second, the result is displayed for 0.8 second and the apparatus then returns to its original state, when the cycle is recommenced. A switch enables any result to be retained for as long as desired, after which continuous counting may be resumed. The result is given in terms of r.p.m. by a display unit consisting of four dekatrons to record thousands, hundreds, tens, and units. The one-second period is controlled by a 4 kc/s. crystal oscillator, acurate to 0.005%, the output of which is divided to produce a 1 c/s. pulse. In addition, a 2 kc/s. signal may be switched and fed to the input terminal to check the operation of the display unit.

The magnetic-drag tachometer seldom had an accuracy of greater than 0.5% at full scale deflection and is subject to ageing, whereas with the electronic precision engine speed indicator an accuracy of 0.1% is easily obtained. At high rates of counting the accuracy becomes even greater, reaching a limit of 0.03% at 3,000 pulses/second, with a one-second count and results better than 0.01% are available when a longer count can be used.

NEW ELECTRIC LAMP SPECIFICATIONS

Report from the International Electro-technical Commission. Readers may be interested in the following summary prepared by the British Lighting Service Bureau of the proceedings of the technical committee on lamps and related equipment during the meeting of the International Commission in Pennsylvania recently:

TUNGSTEN FILAMENT LAMPS FOR GENERAL SERVICE—SPECIFICATION No. 64

By agreement the 2nd edition of this international specification has now been published. The tables are more complete and it has been found possible to dispense with the table of average efficiencies—the table of lumen values being considered sufficient.

The meeting also accepted data pertaining to the reduced efficiency and light output associated with lamps having a life of 2,500 hours instead of the normal 1,000 hours.

TUBULAR FLUORESCENT LAMPS FOR GENERAL SERVICE

The committee had before it a draft specification for tubular fluorescent lamps which has been issued for acceptance by the various countries under the six months rule. Great Britain is accepting the specification, subject to detailed suggestions, and these together with other observations will be submitted for final acceptance.

The specification covers procedure for sampling and testing, gives detailed information on dimensions to ensure interchangeability and specifies certain electrical characteristics.

COLOUR OBJECTIVES

The I.E.C. agreed in principle that the specification should include three colours for high efficiency lamps within the following temperature ranges; 6,500–7,000; 4,000–4,500; 2,800–3,200 deg. K. The Commission found itself unable to agree to detailed colour objectives for these lamps as the various makers differ considerably in their measurement of the lumen output from lamps of a given colour. American and European factories are accordingly embarking upon an interchange of measurements on a set of lamps to be provided by the U.S.A. The tests had to be completed by March 31, 1955, so that the data would be available prior to the International Commission on Illumination which met in June, 1955, in Zurich. (This latter is concerned with colorimetry and photometry while I.E.C. is concerned with the lamp specification).

This part of the proceedings was perhaps the most important for it provided a parallel with the early days of the illumination commission when it was concerned with candle power measurement of incandescent lamps of near black body characteristics. The task now is to get agreement so that a "white" lamp whether towards the red, green or purple will be given the same reading (within a reasonable degree of accuracy) when mesured in any of the various laboratories.

In the meantime an I.E.C. committee of experts will be following up this and other matters in order to complete the fluorescent lamp specifications.

LAMP CAPS AND HOLDERS

Much useful agreement has been reached in connection with standard sheets for lamp caps and holders, some being revision of standard sheets in I.E.C. Publication 61.

The meeting endorsed gauges for interchangeability and safety of Edison Screw lamps and holders (Types E.27 and E.40) and the data will be submitted to the member countries for acceptance.

BALLASTS FOR FLUORESCENT LAMPS

Following a discussion on the "Draft Recommendations for Ballasts for Fluorescent Lamps" which has been issued for acceptance by the member countries, certain detailed changes were made, the most important being the inclusion of a table dealing separately with chokes for 60 c/s as applies in the U.S.A. and for 50 c/s as applies in other countries. The table will give rated watts and objective watts. Objective watts are the same as the rated watts in most countries but in the U.S.A. the objective watts are somewhat lower.

MARCONI INDUSTRIAL TV FOR BRITISH ELECTRICITY AUTHORITY

Behind the announcement that Marconi's Wireless Telegraph Co. Ltd. are to supply eight industrial television equipments to the British Electricity Authority lies an interesting story illustrative of the extreme versatility of this new industrial tool.

For many years past, two major problems have confronted boiler-room engineers; one was the virtual impossibility of knowing exactly what was going on inside the furnace itself; the other, how best to effect a constant supervision of the boiler water-level. Many devices have been tested to overcome these difficulties. Now, after exhaustive trials, Marconi's Wireless Telegraph Co. Ltd. have introduced an Industrial Television equipment which should prove a great asset to the Combustion Engineer, and eight such equipments are accordingly to be installed at the B.E.A.'s new power station, Willington "A" in Derbyshire.

The fuel used for heating the boilers is pulverised coal, which is jet-injected into the furnace with the air stream and is ignited by pilot oil-burners, the latter being extinguished as soon as full combustion has taken place. In such an operation, it is vital to ascertain that the fuel has fully ignited, as a firing failure, if unobserved, could result in a serious explosion.

Hitherto, observation has had to be maintained through inspection ports in the wall of the furnace, a procedure which makes supervision difficult in modern stations where control is exercised from a point which may not be immediately adjacent to the boiler. Experiments were carried out with a Marconi Industrial TV camera, fitted with a special air-and-water-cooled lens, and installed in the explosion door aperture at the base of the boiler. The I.T.V. Control Unit and Monitors were placed at a convenient point alongside the combined Boiler and Turbine Control Panel.

The experiment was successful, the B.E.A. engineers being able to follow, at the Control Panel, all phases of the boiler ignition procedure and to detect conditions of imperfect combustion within the area under observation.

The second experiment concerned the relatively straightforward operation of monitoring the boiler water-level gauge. For mechanical reasons, this gauge is normally located high up, near the top of the boiler, but in spite of this a constant watch has to be maintained upon it, as a lowering of the water-level beyond a critical point would have serious consequences to the boiler, and might well result in its being out of commission for months.

The camera, for the experiment, was fixed at a strategic point, televising the image of the water-gauge to the Monitors at the Boiler and Turbine Control Panel.

One particularly admirable feature of this application of industrial TV is that, unlike all previous electrical alarm devices which have been tried, the TV equipment monitors itself for faults. The presence of the picture on the monitor is absolute proof that the equipment is working, in contrast with conventional alarm devices, where the absence of a warning is not in itself wholly conclusive evidence that all is well; it could easily be that some part of the alarm equipment is out of action.

Hitherto, the high cost, physical size and complexity of operation has limited the use of television for industrial purposes. Now, the new Marconi equipment, with its camera weighing only 4½ lb., its simplicity of operation—no more difficult than that of a television receiver—and its low cost (basically in the region of £500) has provided, for the first time, a sound economic proposition for use in the office and industry.

THE LATEST WAY TO SEEK A FORTUNE

PROSPECTING FOR URANIUM BY AIR

A Mexican burro, a shovel, a shallow tin pan, a big moustache, and a wide-brimmed sombrero were once the standard equipment of the prospector. Today, his ultra-modern counterpart flies over the barren hills in a light plane equipped with electronic instruments to seek out the rich ore.

Vernon J. Pick, of Saratoga, California, typifies the favoured few who have "struck it rich" in uranium. He called upon his long-time flying experience as a bush pilot and equipped a small "Aero Commander" plane with air-borne scintillation equipment. This is a sensitive device which measures variations in natural radioactivity of the earth.

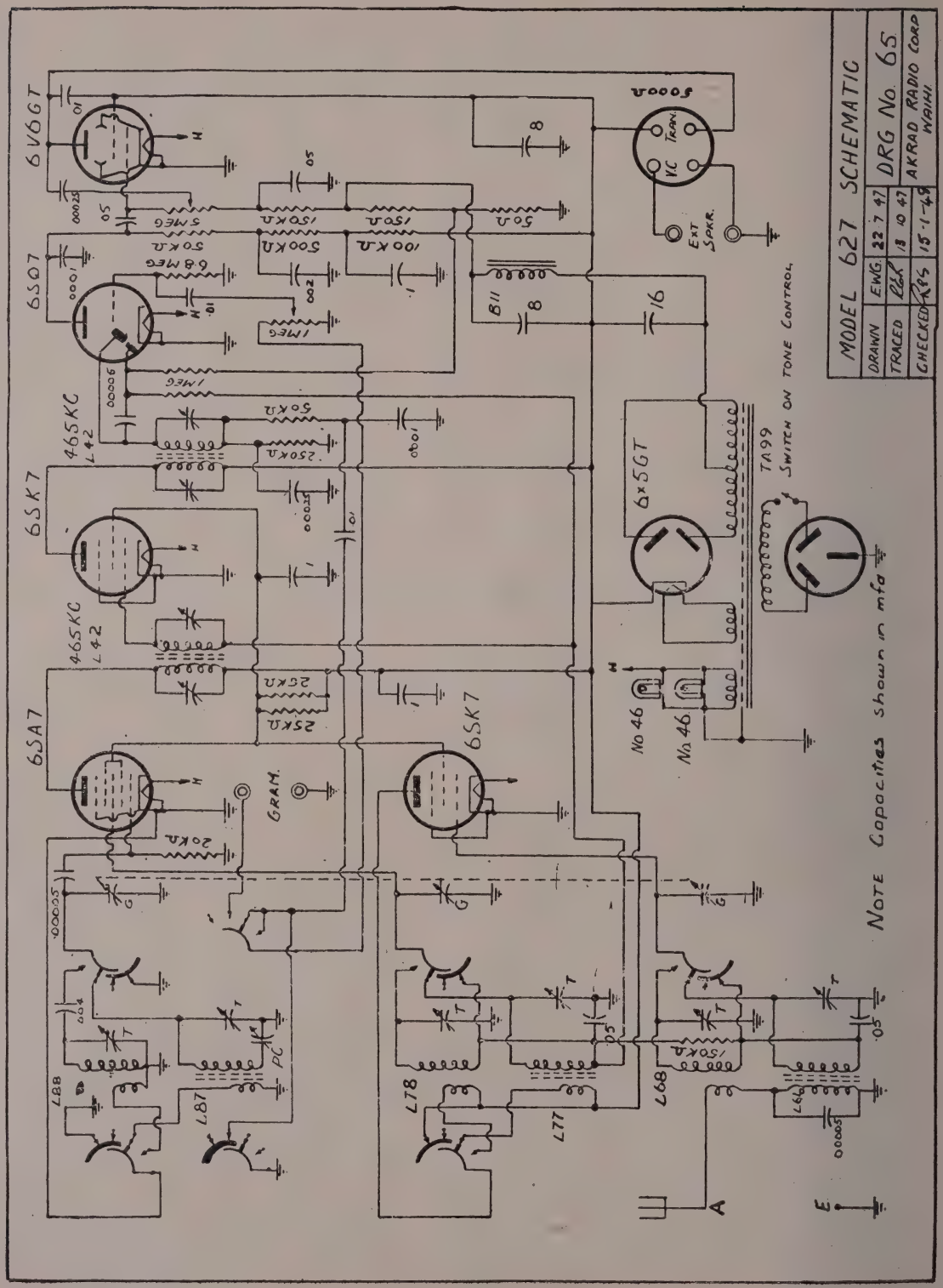
Next, he visited the flight test laboratories of Raytheon Manufacturing Company at the Hanscom Air Force Base in Bedford, Mass. There, his aeroplane was equipped with an "electronic yardstick"—a Raytheon radar altimeter. This instrument gives a constant, accurate reading of the plane's height above the ground, rather than height above sea-level. The conventional altimeter is merely a sensitive barometer, which measures air pressure as a function of height, but the radar altimeter sends speed-of-light signals downward and "bounces" them off the ground. The signals return to the plane, and the altimeter automatically measures the time interval and converts it into a reading of feet. The entire device, including the transmitter, mounted flush under the wing, weighs only 30 pounds.

With these two marvellous instruments in his plane, Mr. Pick began following an ingenious prospecting technique. Knowing that radioactivity is stronger closer to the ground and that its strength drops off proportionately with altitude, Mr. Pick realized that by flying in geometric patterns above the earth at a precisely-known altitude, he could plot the readings of the scintillation equipment on a map of the area and come up with a highly accurate chart of the radioactivity in the area. Whenever he dropped down closer to the earth for a detailed "spot check," he could correlate the radioactive readings with the true altitude and determine whether it would be worth while to explore that area on foot.

The Raytheon altimeter, in addition to its use as a prospecting tool, also offers a margin of safety for this hazardous type of flying. Mr. Pick can pre-set the altimeter in such a way that it will automatically flash a light or sound a warning horn in the cockpit whenever the aeroplane goes below a certain altitude.

Since uranium is now a vitally important metal in the nation's defence programme, Mr. Pick feels that his prospecting innovation will eventually have a considerable impact on the industry. He feels that the quickest and most practical methods of prospecting must be developed.

For the Serviceman Circuit Diagram of Regent Pacific Model 627



FOR THE TECHNICIAN

Repairs to, or Replacements of, Swiss Dandy Electric Shavers Models R.5 and R.4

The great majority of Swiss "Dandy" Electric Shaver faults consist of repairs or replacements to the shaving heads. These repairs can be carried out in a few minutes by any retailer without special tools and without any specialized knowledge or experience in electric shaver repairs.

When a Swiss "Dandy" electric shaver is brought in for service then it is a comparatively easy matter from the client's description of the fault to determine which component is defective. From there, the service scheme merely means removing the defective component assembly and replacing with a new one.

SERVICE INSTRUCTIONS R.5 MODEL

The R.5 model is the white plastic shaver contained in a mottled plastic carrying case.

1. **Shaving Head Faulty:** Remove complete shaving head by unscrewing from body of shaver and replace with new head. Return defective head with guarantee tag, if under guarantee, to Russell Import Co. Ltd., Wellington, for replacement.

2. **Cutting Head Faulty:** Remove cutting head by pulling complete head from shaver body, replace new head. Return procedure as above.

3. **Broken Switch Toggle:** Remove both shaving heads as described above, take off chrome retaining ring, then with thumb-nail widen joint of the two plastic body halves, insert screwdriver and slide each half of the plastic body off. Remove switch toggle and replace with new one. Return procedure as above.

BACK NUMBERS OF "R. & E. R."

BACK NUMBERS ARE AVAILABLE FROM:

S.O.S. Radio Ltd., 283 Queen Street, Auckland.
S.O.S. Radio Ltd., 1 Ward Street, Hamilton.
Webb's Radios Ltd., 11 Wellesley St. E., Auckland.
Tricity House Ltd., 209 Manchester St., Christchurch.
Ken's Ltd., 142-144 Stuart Street, Dunedin.
Fear's Radio and Cycle Co. Ltd., 31 Willis Street, Wellington.
The Radio Service Co., 83 Guyton Street, Wanganui.
Technical Book and Magazine Co., 295-299 Swanson Street, Melbourne, Australia.

4. **Broken or Cracked Body Pieces:** Dismantle as above and replace broken half or halves, return procedure as above.

Faults within the motor assembly itself require special tools and it is not recommended to be undertaken by the retailer unless he has the special tools and equipment required.

For faults of this nature, remove shaving heads, retaining ring and plastic bodies and switch toggle and replace defective motor assembly complete with new one. The defective motor assembly, together with the guarantee tag, is then forwarded to Russell Import Co. Ltd., Wellington, for repair and this will be returned after service.

MODEL R.4

In general, this service scheme operates the same as the procedure outlined in detail in the Model R.5 Swiss "Dandy" Electric Shaver Manual. The adjustments which differ from the R.5 model details are as follows.

The R.4 model is the older type shaver which generally has a brown plastic body and is contained in a zipped leather carrying case.

1. **Shaving Head Faulty:** Same procedure as R.5 model. N.B.—Model R.4 and R.5 shaving heads are interchangeable.

2. **Fixed or Moving Blade on Trimming Head Faulty:** Remove moving blade by applying pressure with forefinger to centre of moving blade, it will then be found that this will slide off easily. Remove fixed blade and slider and replace whichever component is faulty.

3. **Faults other than the ones outlined:** Remove shaving head, trimming head blades and slider then telegraph RIMCO, Wellington, as follows: "Forward Dandy Part 4000 (Signature)." A complete motor unit will then be posted immediately.

The faulty unit less all the parts removed should then be forwarded to Russell Import Co. Ltd., P.O. Box 102, Wellington, together with the guarantee tag if the shaver is still within the guarantee period.

Circuits for Tape Recorders

(Continued from page 31)

will most of the relatively inexpensive dynamic microphones that are available.

With this mixing circuit, there is no need to have any input switching. Connecting either or both the input signals simultaneously will have no effect on the other. For example, if it is desired to record some speech from the microphone, and to use a radio set for supplying some background music, the procedure will be as follows. The recording gain control will be used in the usual way to adjust the speech level so that overloading does not occur. Then, the input from the radio set can be adjusted by means of its own volume control, to provide a background of the required strength. It is worth noting in this connection, that if the background music is strong enough to show much deflection on the volume indicator, it will be much too strong in relation to the speech. The correct level can only be found by a process of trial and error, and the point to remember is that the volume indicator cannot be used to gauge the level of the background music. If the mixer circuit is used to have two sources of material available without having to throw a switch, so that one source or the other can be recorded simply by turning up the appropriate volume control, such things as gradual fades from one to the other can be accomplished quite easily by working both controls simultaneously.

Recording from a gramophone record can be done either from the voice-coil of the main amplifier, or from the output of the preamplifier, which can be fed to one of the input terminals. In general, one will want to build in the microphone pre-amplifier on the recorder chassis, in which case the builder can please himself whether or not he fits an additional gain control between the pre-amplifier and the mixer valve. If the mike pre-amplifier is sufficiently hum-free, the microphone can be disabled without unplugging it, by having a switch which short-circuits the grid of the pre-amplifier tube to earth. If it is not, the switch can be connected between the pre-amplifier and the mixer, but a double RC coupling will be needed so that neither the plate of the pre-amplifier nor the grid of the mixer will be shorted DC-wise.

Electronics in Medicine

(Continued from page 45)

noise out of the amplifier input. The output of the mike is applied to a three-stage conventional RC-coupled amplifier having a gain of approximately 80 decibels. This is followed by a low-pass filter.

The output of the filter is introduced into a pulse-stretching and equalizing circuit in the form of a monostable multivibrator. A neon tube connected to the plate of the normally-nonconducting triode of the multivibrator flashes each time a pulse triggers the multivibrator. This neon tube, located on the instrument panel, serves as an indicator which permits the operator to adjust the gain in the system to the characteristic sound level of the subject.

The system for discrimination between the sound pulses produced within the artery and other noise signals is based on the fact that the sounds within the artery are accompanied by corresponding slight increases in pressure within the armband. The coincidence circuits reject all sound pulses that do not coincide with the necessary pressure pulses. As a further protection, these circuits prevent actuation of the relay system by any sound pulse that is not followed by a similar pulse within one-half of a second.

The blood pressure measurement system has been used on many different humans for periods ranging from an hour to as long as 21 hours. Generally, it was said, the patients were not upset by the apparatus. Operators have found the equipment simple to adjust and anaesthetists have called the instrument a blessing, for it tells them in simple, numerical form, in continuous fashion, the exact condition of the patient during surgery.

"R. & E." High-quality Nine

(Continued from page 22)

of the R.F. end of the set, but in practice it is on the same wafer as S_{1a}. S_{1b} and S_{1c} are together on a second wafer, while the remaining two sections, S_{1d} and S_{1e} are on a third. These sections are concerned only in switching the selectivity of the tuner from narrow to broad, on the "Distant" and "Local" positions of the switch, respectively. On the two gramophone positions therefore, the circuits of the two I.F. transformers are incomplete, but this does not matter at all, because in these positions the H.T. supply to the tuner is disconnected anyway.

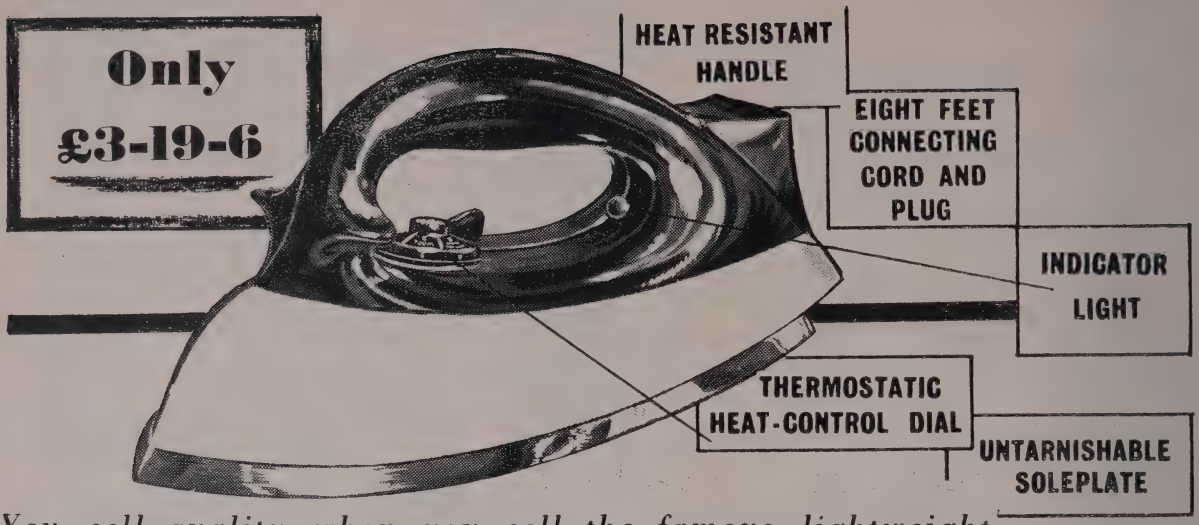
TRADE WINDS—Continued from page 43.

James N. Kirby Manufacturing Pty. Ltd., Sydney, will be licensed to produce the complete Avco line of Crosley, Bendix and Moffatt household appliances.

The objective for 1956 will be the production of Bendix automatic washers, and stoves designed by Crosley of U.S.A. and by Moffatt of Canada."

(Fisher and Paykel Ltd. are New Zealand distributors of Bendix and Turnbull and Jones Ltd., of Moffatt. The sole New Zealand distributors of Crosley Shelvador refrigerators and Kirby air conditioning units are G. A. Wooller and Co. Ltd.).

BACK NUMBERS OF "R. & E."
Available from our Office,



You sell quality when you sell the famous lightweight

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Customer goodwill depends on satisfied customers, and here is something that will satisfy EVERY CUSTOMER.

Thermostatic heat-controlled dial; untarnishable soleplate; indicator light; heat-resistant handle; 8 ft. connecting cord —every feature that every customer wants in an iron is there at the amazingly low price of ONLY £3/19/6 retail.

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Electric Radiator

ANOTHER PANAMA PRODUCT

- ★ Two 10-inch bars
- ★ Individual Switching
- ★ Red Glow Visible at Base
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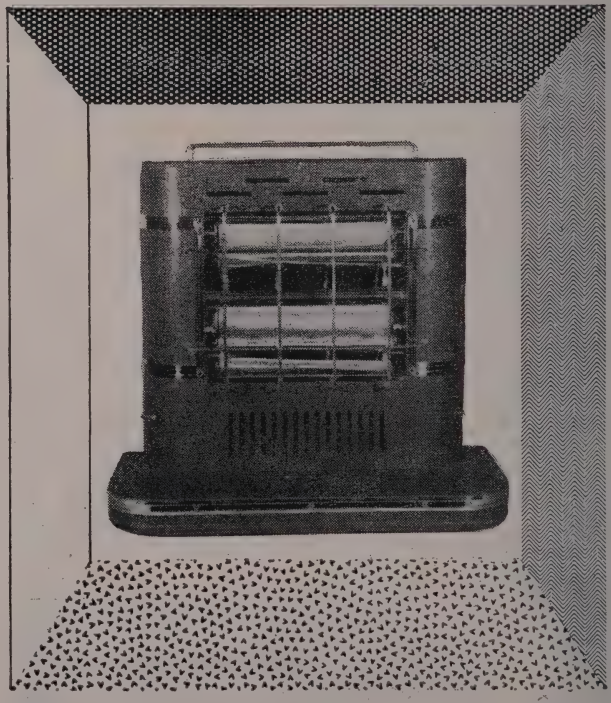

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CORY-WRIGHT and SALMON LTD.

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silent . . .

trouble free . . .

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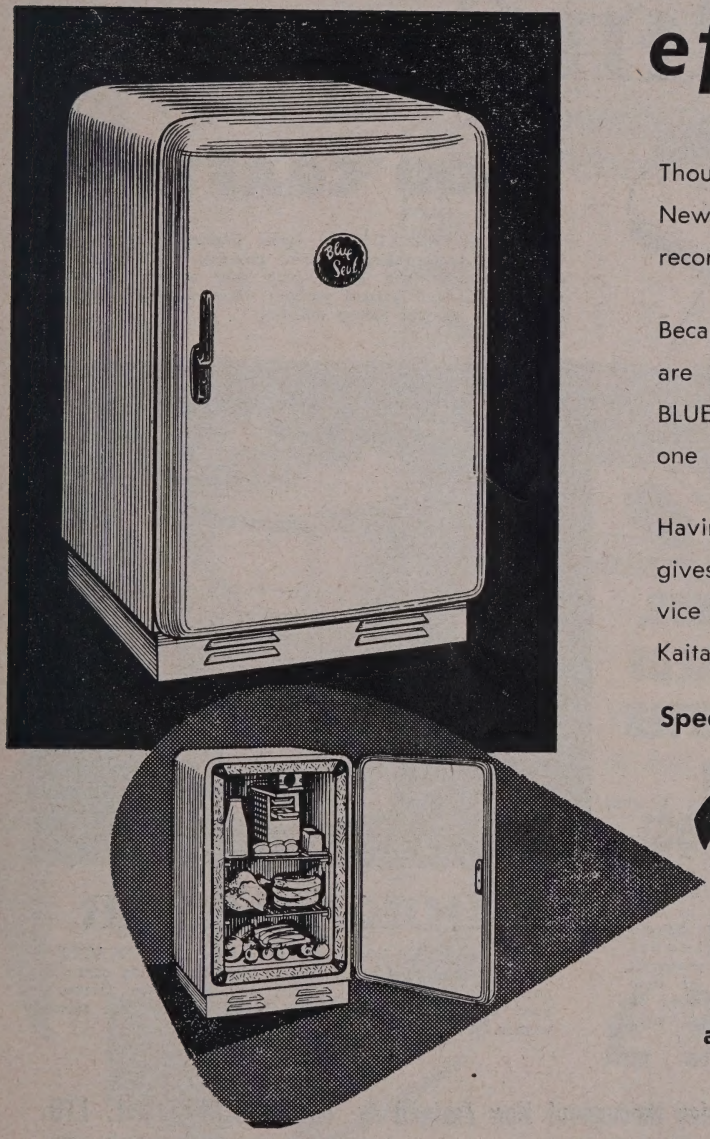

Thousands of BLUE SEAL Refrigerators throughout New Zealand have established an unsurpassed record of efficient, trouble-free performance.

Because of this, the makers, Turnbull & Jones, are proud to announce that the guarantee on BLUE SEAL Refrigerators has been increased from one to five years.

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REFRIGERATOR

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Master Distributors:

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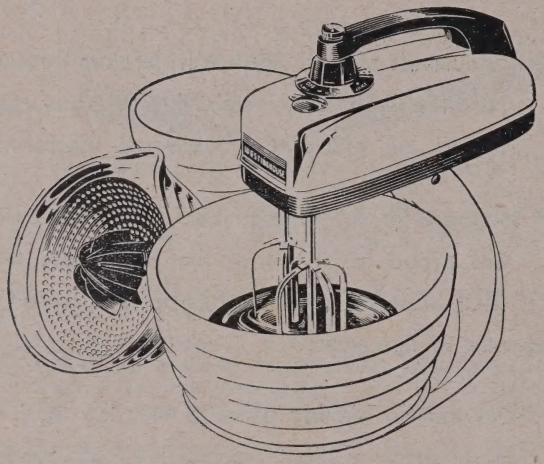
Auckland, Wellington, Christchurch, Dunedin, Hamilton, Palmerston North, Nelson and Invercargill.

EVERY HOUSE NEEDS—

Westinghouse



FOOD CRAFTER

The Mixer with ALL the latest improvements . . . Thumb-tip beater ejector; Front mix-dial of 20 speeds; Revolving bowl and Pitcher-type juice crafter. Mixes the HEAVIEST batters without 'Slow down'. Sealed lubrication. A real money spinner.

COOK·N·FRYER

Cooks everything from soup to dessert AUTOMATICALLY! 'True-temp' and 'Colour-glance' controls operate automatically from 150 to 425 deg. Exclusive 'Flared' bowl fries MORE food with LESS fat. A sure sales winner.

MIXES, GRINDS, GRATES, SHREDS LIQUEFIES IN SECONDS!

The wonder-working KWIKMIX has sold in thousands in New Zealand and the demand continues! Beautifully produced recipe book of new KWIKMIX ways of preparing food, supplied FREE!

Distributed throughout New Zealand By H. W. CLARKE N.Z. LTD.
ARNOLD WRIGHT LTD. - AUTOCRAT DISTRIBUTORS LTD.

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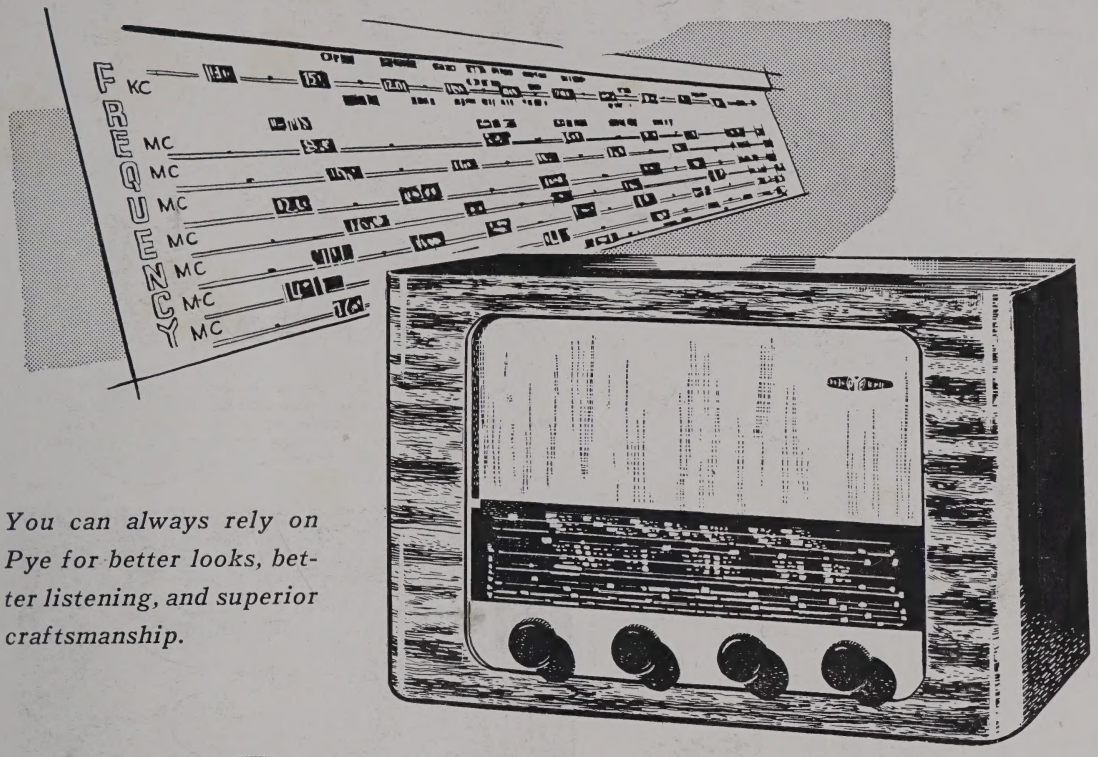
For Better Looks & Better Listening ...



You can always rely on Pye for better looks, better listening, and superior craftsmanship.

The Pye model 77 brings the luxury of full Bandspreading to span the world of radio entertainment. In its gleaming walnut cabinet that delights the eye this 5-valve, 8-wave bandspread model retails at only

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Radio and Television

Sole New Zealand Distributors: PYE (NEW ZEALAND) LTD., P.O. BOX 2839, AUCKLAND.

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'SCOTCH BOY'

Magnetic Recording TAPE

ANOTHER 3M COMPANY PRODUCT

"Scotchboy" perfected dry lubrication does away with blocking and sticking, with wow and flutter. Strong and non-kinking, plastic-backed "Scotchboy" runs smoothly and gives perfect reproduction at all tape speeds.

MAGNETIC DATA:

Coercivity . . . . 240-260 Oersteds
Total Remanent Flux. 0.4/0.5 lines ¼ in. width
Uniformity throughout a reel . . . 0.5 d.b.

PLAYING TIMES (per track):

Reels	Spool size	3¾ in./sec.	7½ in./sec.	15 in./sec.
3280 ft.	11½ in.	160 min.	80 min.	40 min.
3000 ft.	11½ in.	150 min.	75 min.	37½ min.
2400 ft.	10½ in.	120 min.	60 min.	30 min.
2250 ft.	9 5/16 in.	110 min.	55 min.	27 min.
1200 ft.	7 in.	60 min.	30 min.	15 min.
600 ft.	5 in.	30 min.	15 min.	7½ min.
300 ft.	3⅝ in.	15 min.	7½ min.	3¾ min.

FREQUENCY RANGE:

50 c/s. to 10 kc/s. at a playing speed of 7½ in./sec.

"Scotchboy's" extra sensitivity and ouptut means you can record either at lower levels for the same output with lower distortion or at the same level for increased undistorted output. Signal/Noise ratio is improved as well.

Manufactured by

MINNESOTA MINING AND MANUFACTURING COMPANY LTD.

167 Strand, London and Slough

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